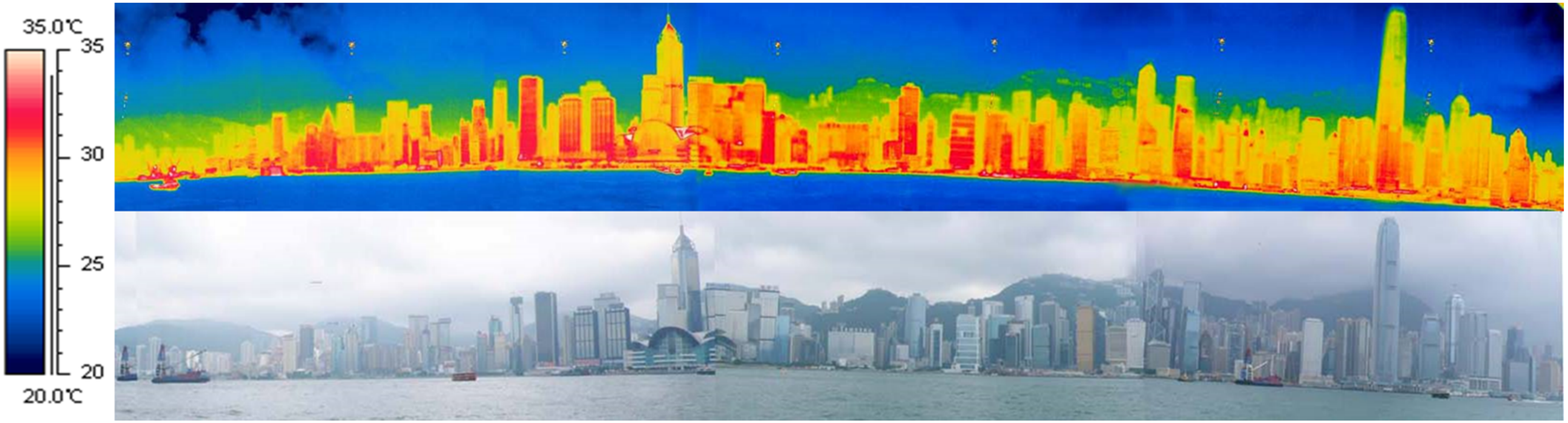
Hong Kong 2 pm May 27 2008

Yang and Li, Atmospheric Environment



WUDAPT: World Urban Database and Access Portal Tools

The Physical Geography of Cities: A global census.

Benjamin Bechtel, Gerald Mills, Linda See, Jason Ching, Iain Stewart, Paul Alexander, Johann Feddema

Overview WUDAPT part 1

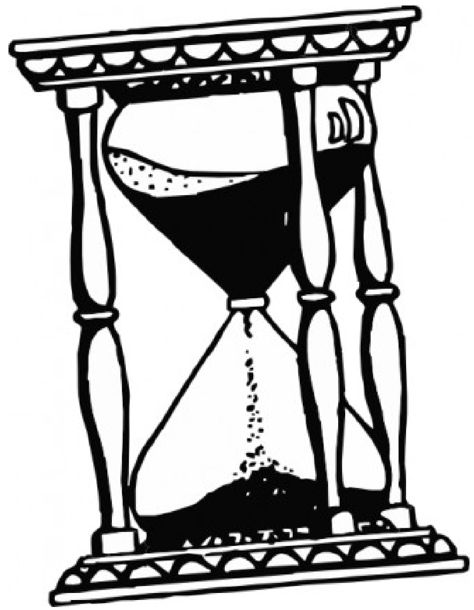
I. Lecture

1. Urban climate
2. Urban surface
3. The Global Urban Knowledge Gap
4. WUDAPT
5. Mapping methodology

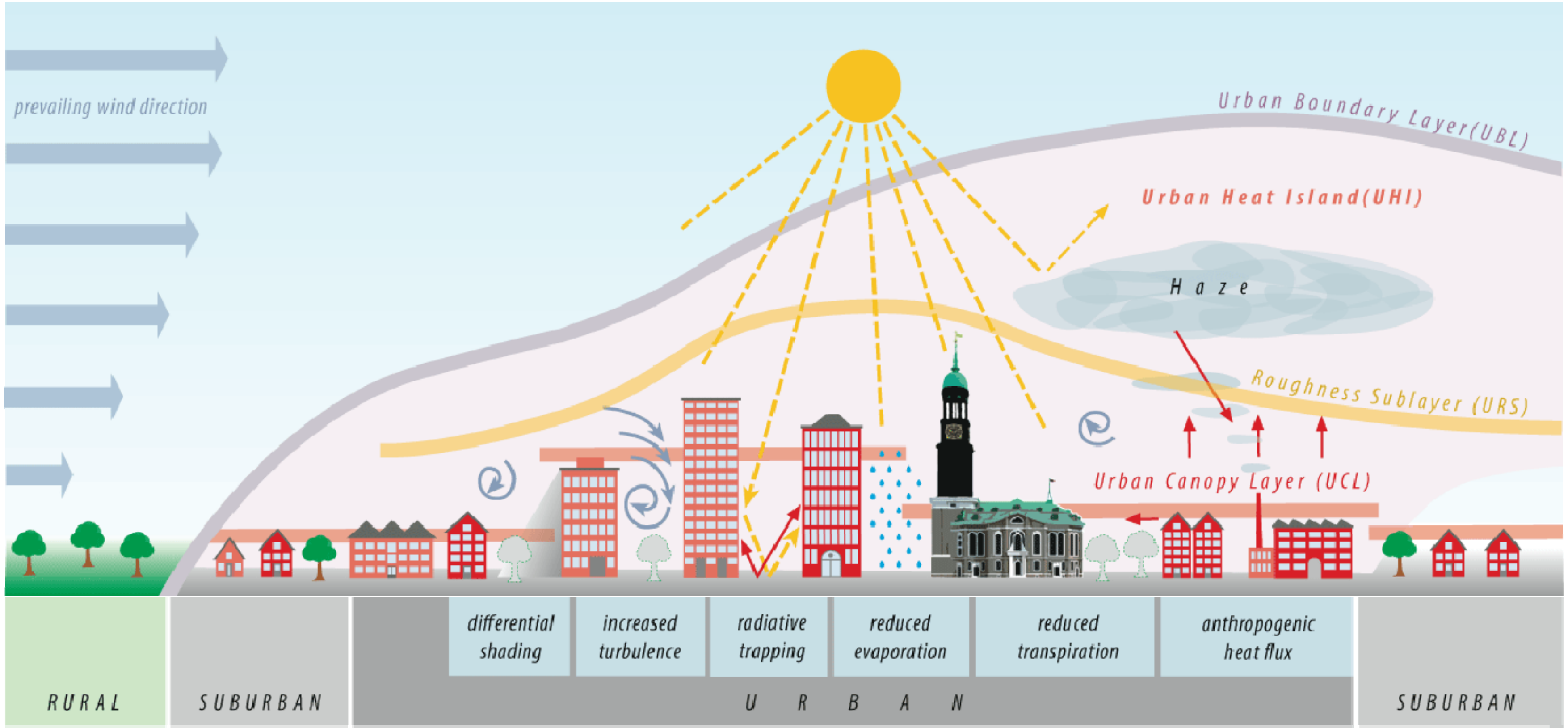
II. Local Climate Zones

1. LCZ typology
2. Quiz

III. Getting started – collect training areas



1. Urban climate



B. Bechtel nach D. Grawe, Graphik: C. Carstens

1. The Urban Climate Effect

The effect of the city on the overlying atmosphere is due to two distinct but related features:

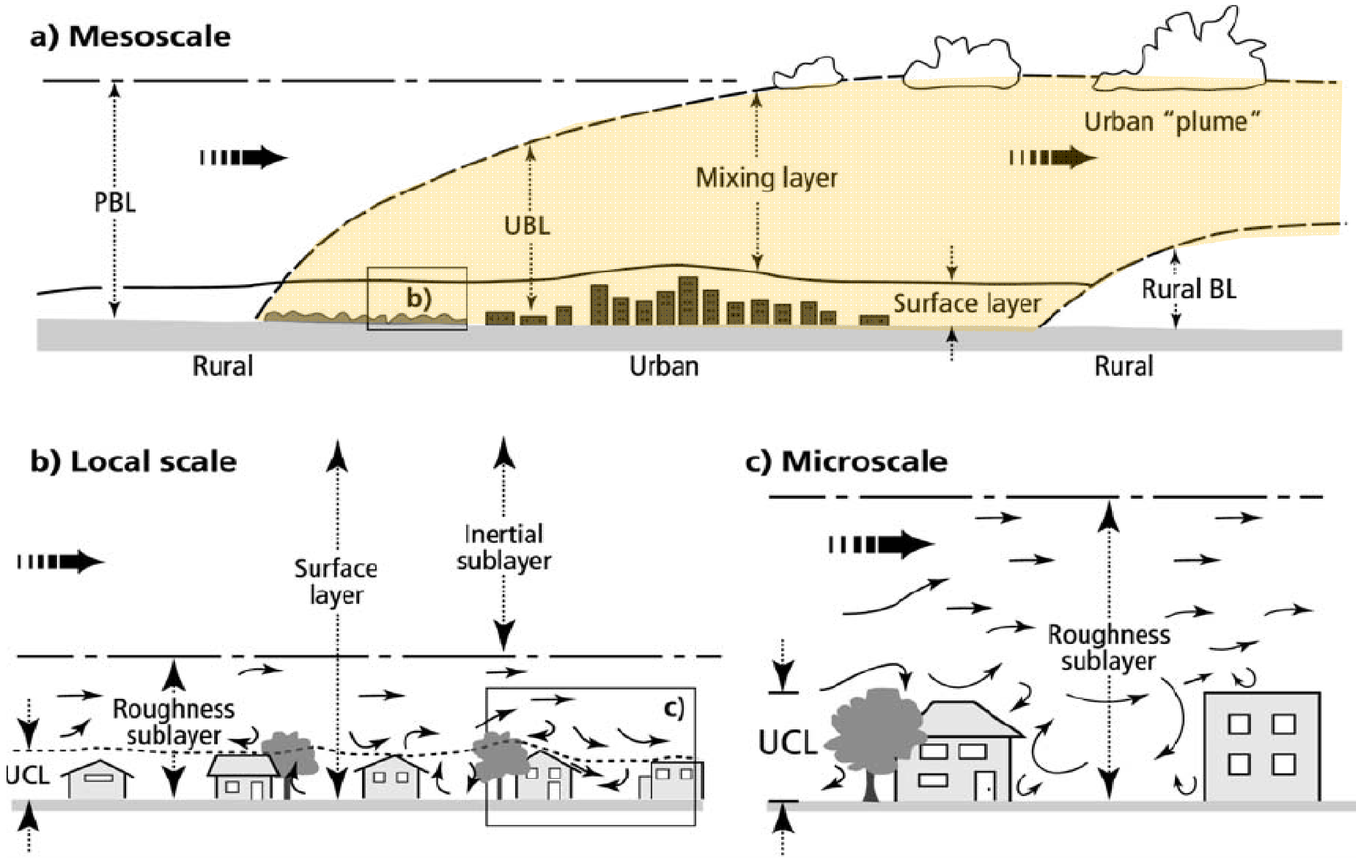
Urban form which modifies surface energy exchanges

- Surface cover (percent vegetated)
- Urban fabric (concrete/asphalt/glass)
- Urban geometry (building height, street width).

Urban function which results in waste emissions of energy and materials:

- Transport
- Buildings
- Industry

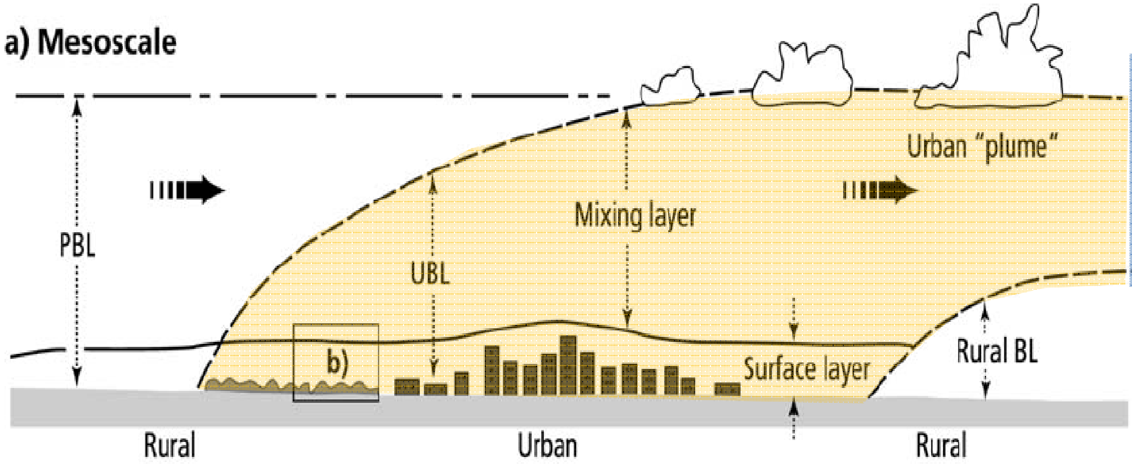
These generate distinct climates at different urban scales



The climate impact of cities takes place at a number of scales; the most profound changes occur at the scale of the city itself. However, the effects of the city extend regionally and globally.

Source: Oke 'Urban Observations', Chapter 11 in WMO guidelines on meteorological observations.

Scale



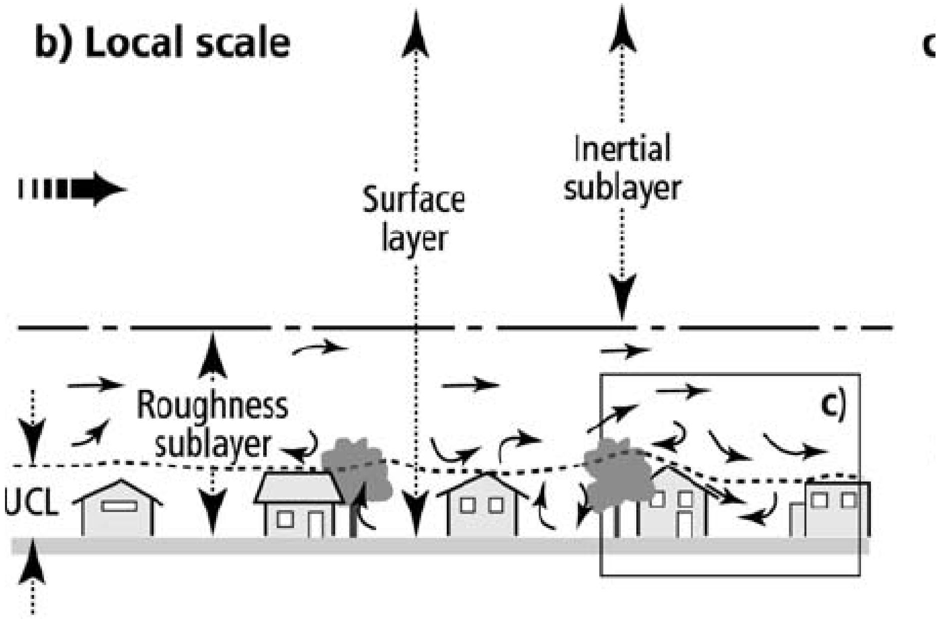
Extra-urban effects mixed downwind.

At this scale it is the **UBL** that of interest, which **integrates the effects of the urban 'surface'** below. The UBL is advected downwind as an elevated plume that is gradually diluted.

Image of Dallas, taken by Giovanni Paccaloni, January 2009

Scale

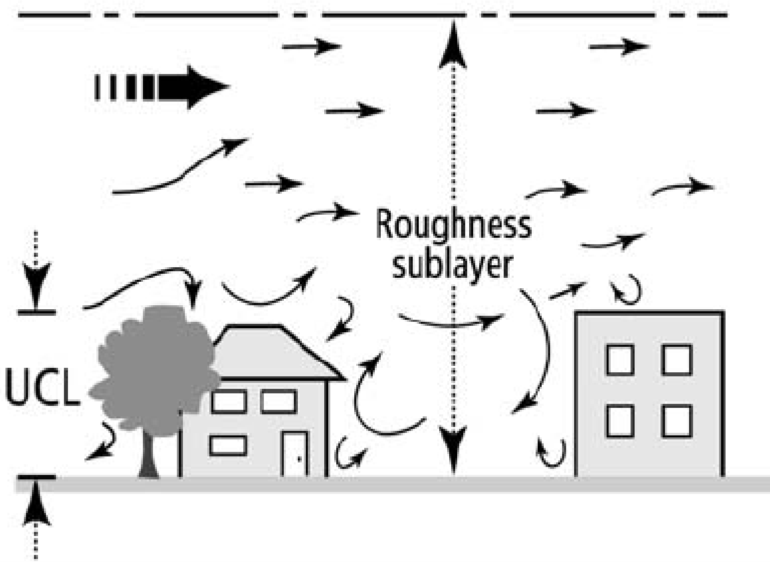
Distinctive urban ‘neighbourhoods’ in Chicago. Note the change from impervious to vegetated and from tall to low buildings.



Urban heterogeneity can be managed as **most cities can be characterised by distinct neighbourhood** types where the land cover exhibits the **same internal variations**. Each neighbourhood has a distinct impact on the overlying air

Scale

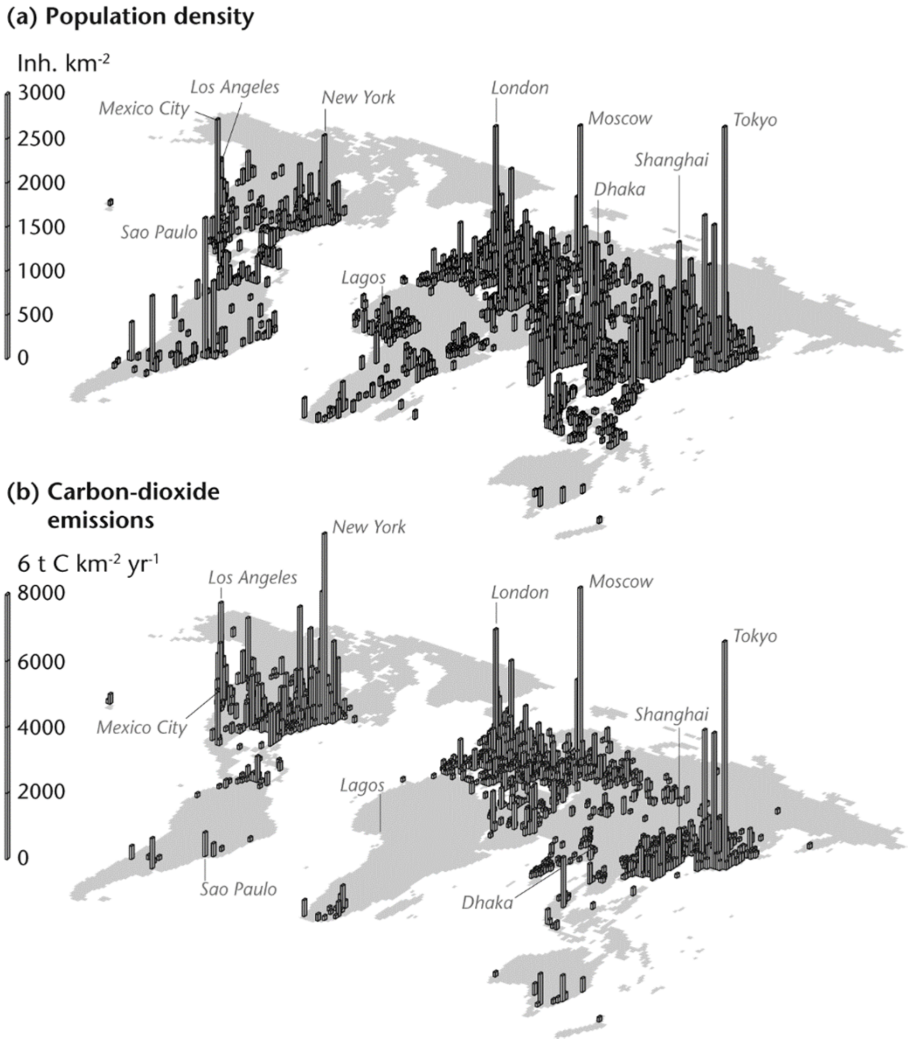
Athens



The micro-scale environment is governed by the dimensions of individual roughness and their radiative and thermal properties. The airflow at this level creates a deep roughness sub-layer where observations display great variation over short time periods.

The urban canopy layer (UCL) is the zone of human occupation.

Urban form and function



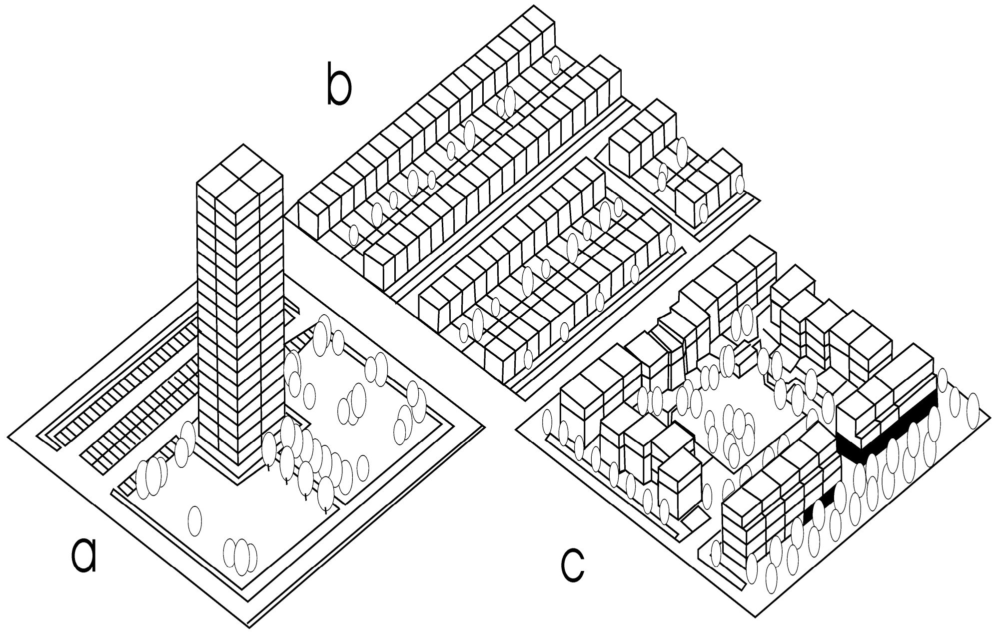
Key urban form drivers of energy and GHG emissions are density, land use mix, connectivity, and accessibility. These factors are interrelated and interdependent. Pursuing one of them in isolation is insufficient for lower emissions.

Source: IPCC, 2014 AR5 III

(a) Population density for 1995 at a resolution of 1 x 1º. Bars are only shown for grid cells with more than 50 Inh. km^{-2}. (b) Carbon dioxide emission estimates from fossil-fuel burning, hydraulic cement production, and gas flaring for 1995 at a resolution of 1 x 1º. Bars are only shown for grid cells with more than 100 t C m^{-2} $year^{-1}$. Data source: A. L. Brenkert, Oak Ridge National Laboratory, DOI: 10.3334/CDIAC/ffe.ndp058.2003

Maps created by Andreas Christen, UBC

Urban form and function



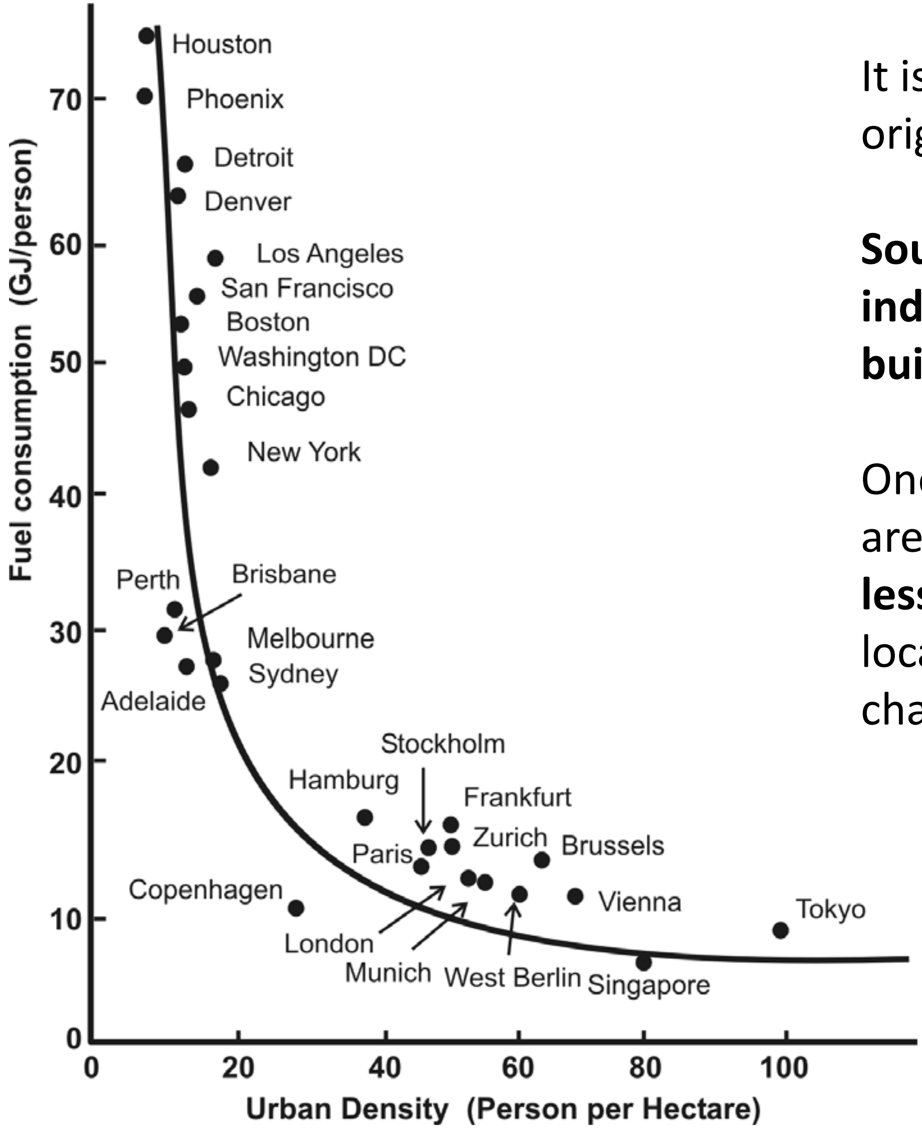
Place	Dph	Pph
UK average	25	<100
Garden City	45	125
Urban Task Force	75	125
30 Obstruction	**200**	**500**
Barcelona Centre	400	800
Hong Kong	1000	5000

Each design generates a built density of 75 dwellings per hectare. Each will generate entirely different microclimates. The Urban Task Force (1999) Towards an Urban Renaissance

Dwellings per hectare (Dph) and population per hectare (Pph) for different places.

Steemers K.(2003).

Urban form and function



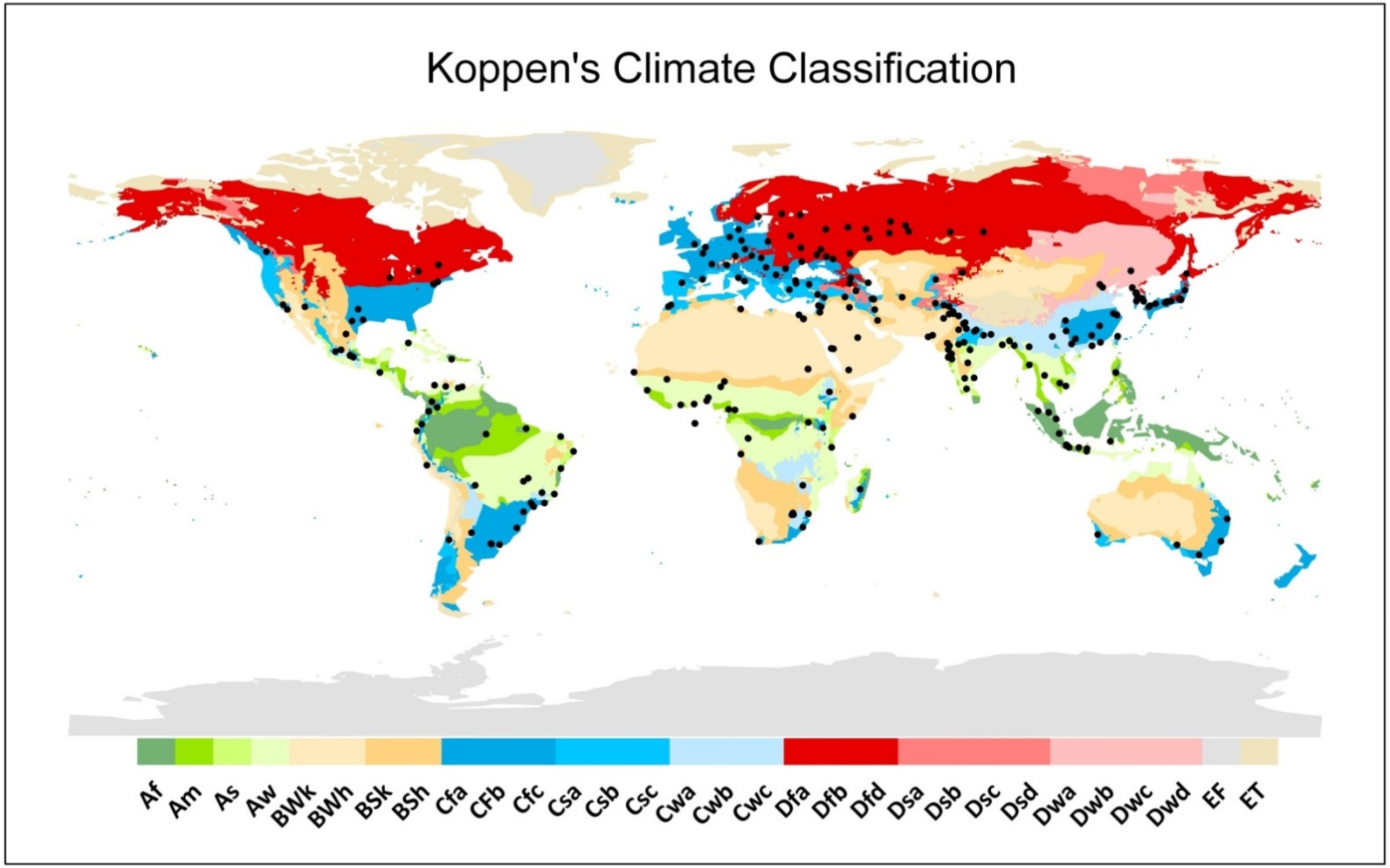
It is estimated that 75% of final CO2 use originates from cities.

Sources of CO2 within cities arises from industry (production), transport and buildings (heating, cooling, lighting, etc.).

One argument is that **dense settlements** are more sustainable in that they **consume less energy and generate less CO2**. Hence, local authorities can mitigate global climate change by modifying urban form.

Source: Newman PG, Kenworthy JR (1989) Cities and Automobile Dependence: an International Sourcebook, Gower Technical, Aldershot

Global Urban Geography

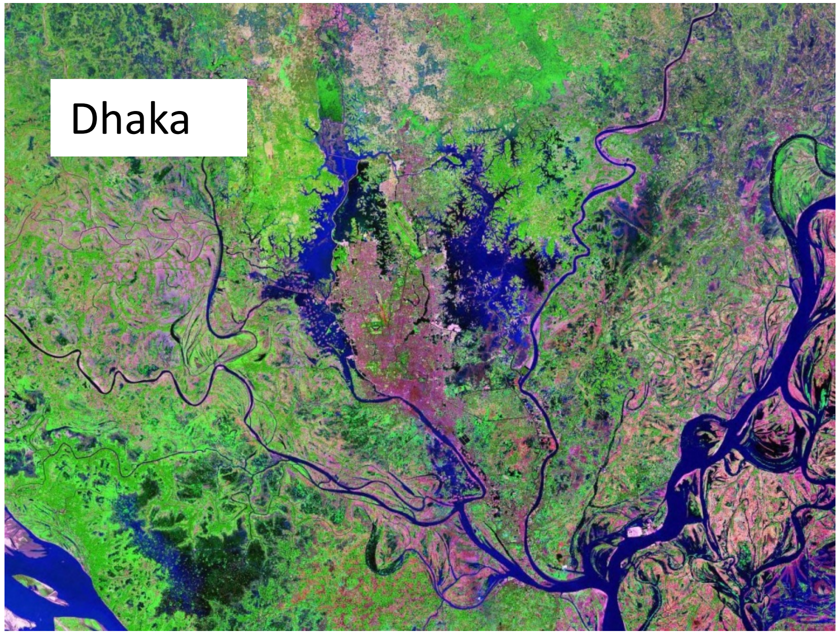


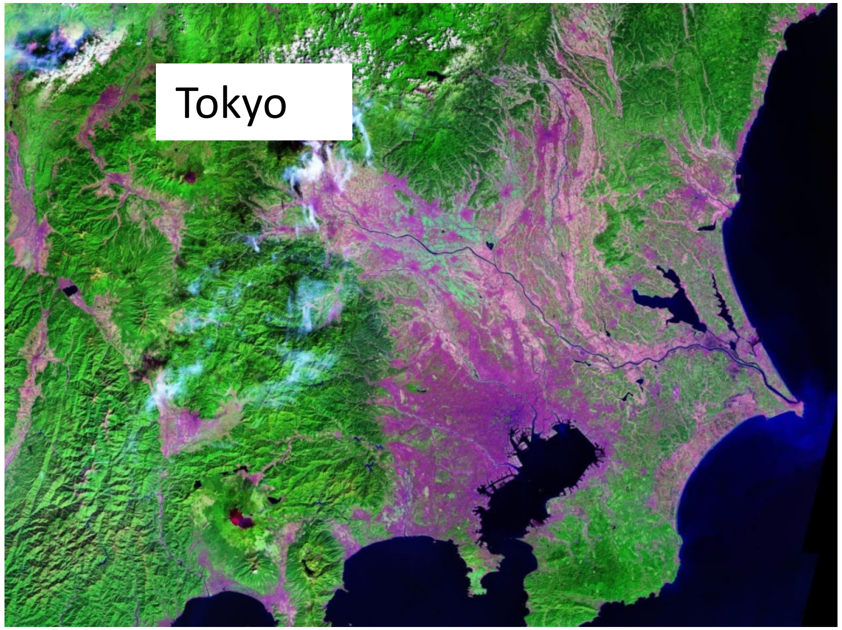
Cities (>1 million) over a map of global climates sourced from http://koeppen-geiger.vu-wien.ac.at/.

Global Urban Geography

The urbanised landscape occupies <3% of the land area of the planet but houses over 50% of the global population and much of the built infrastructure.

Cities tend to be located in specific topographic settings: in valleys or basins, at low elevation and near coasts.





Source:http://geology.com/world-cities/

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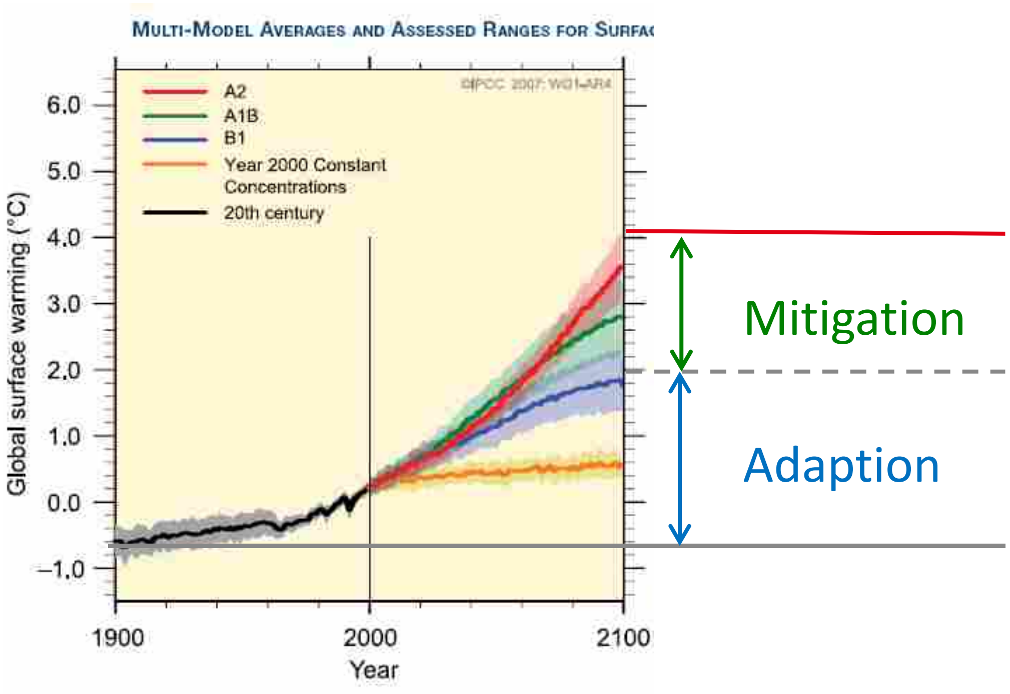
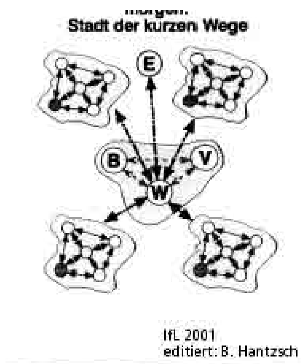
Cities and climate change



Double role

Trade-offs!

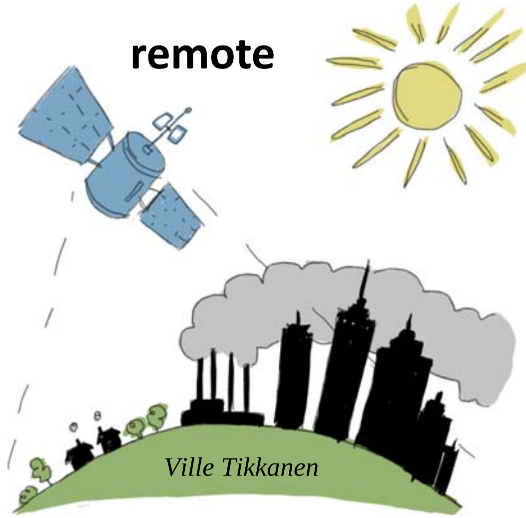


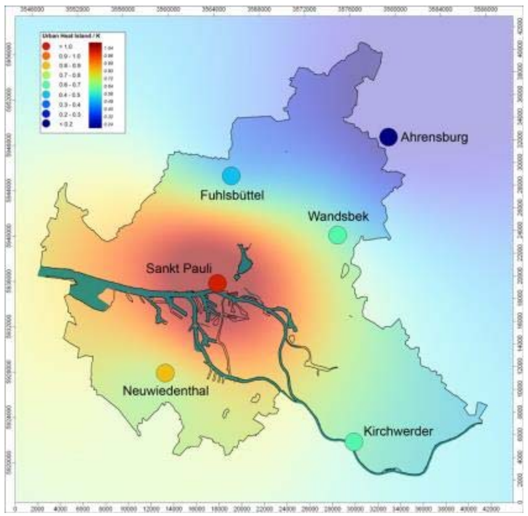
2b. Heterogeneity

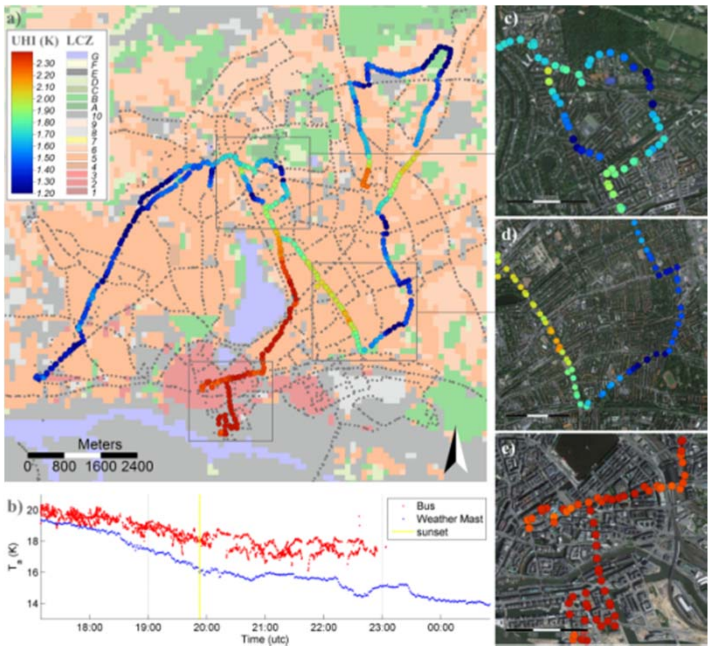
Measuring the effects of a simplified city on the atmosphere using an outdoor model; scaled model (1/5) used for establishing form-climate links. The Kanda Lab Japan.

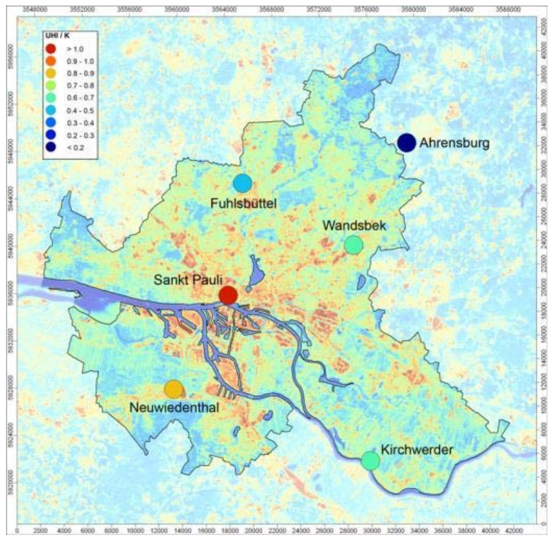
Progress in the field of urban climatology has been achieved by controlling aspects of urban form and examining the atmospheric response through models and measurement.

Monitoring – observation methods









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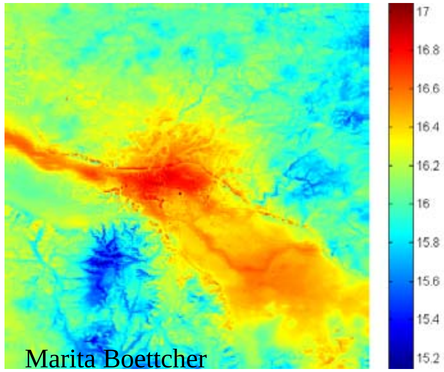
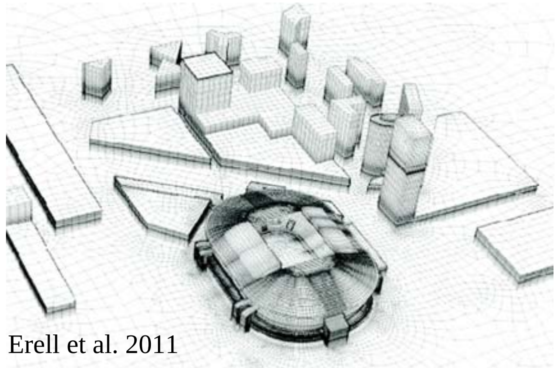
Models

„Essentially, all models are wrong, but some are useful.“

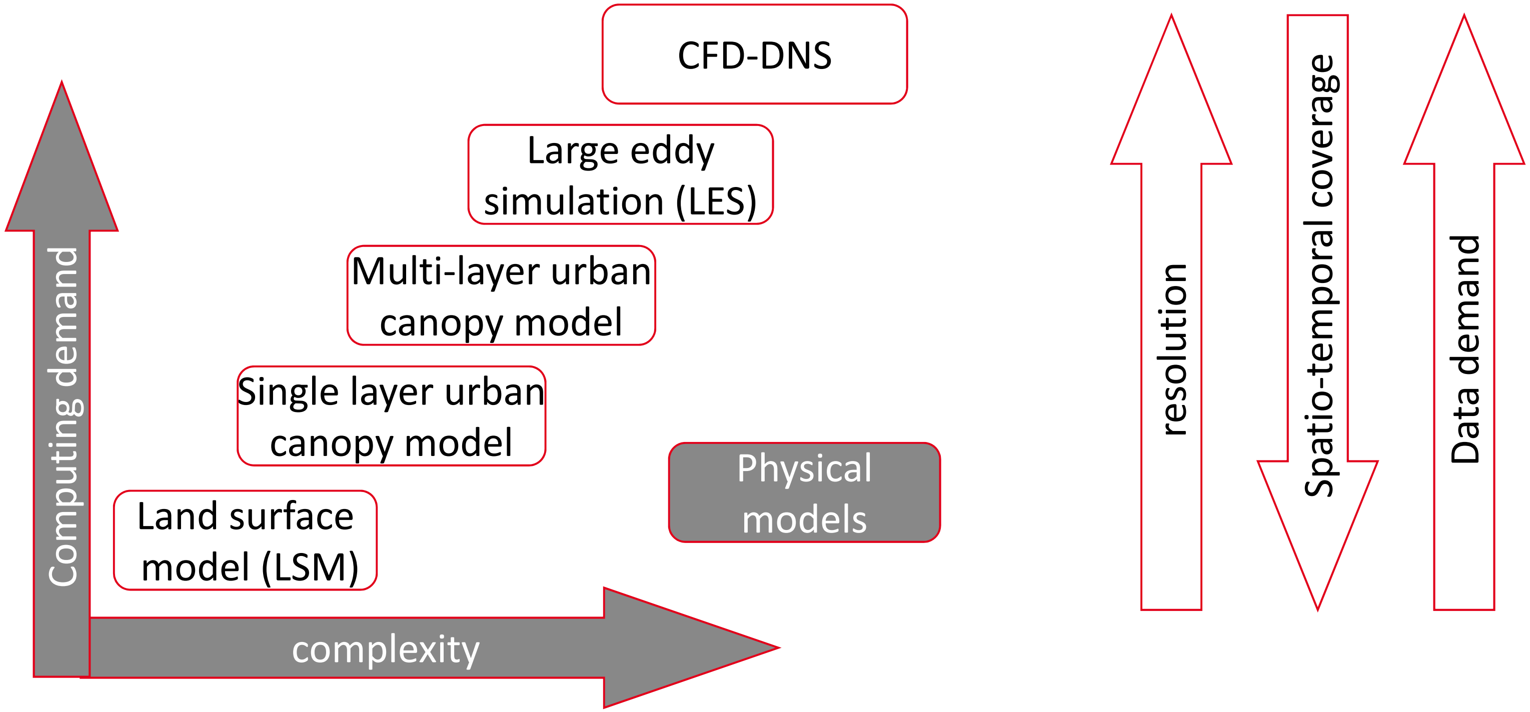
(George Box, 1987)



Marita Boettcher



Erell et al. 2011



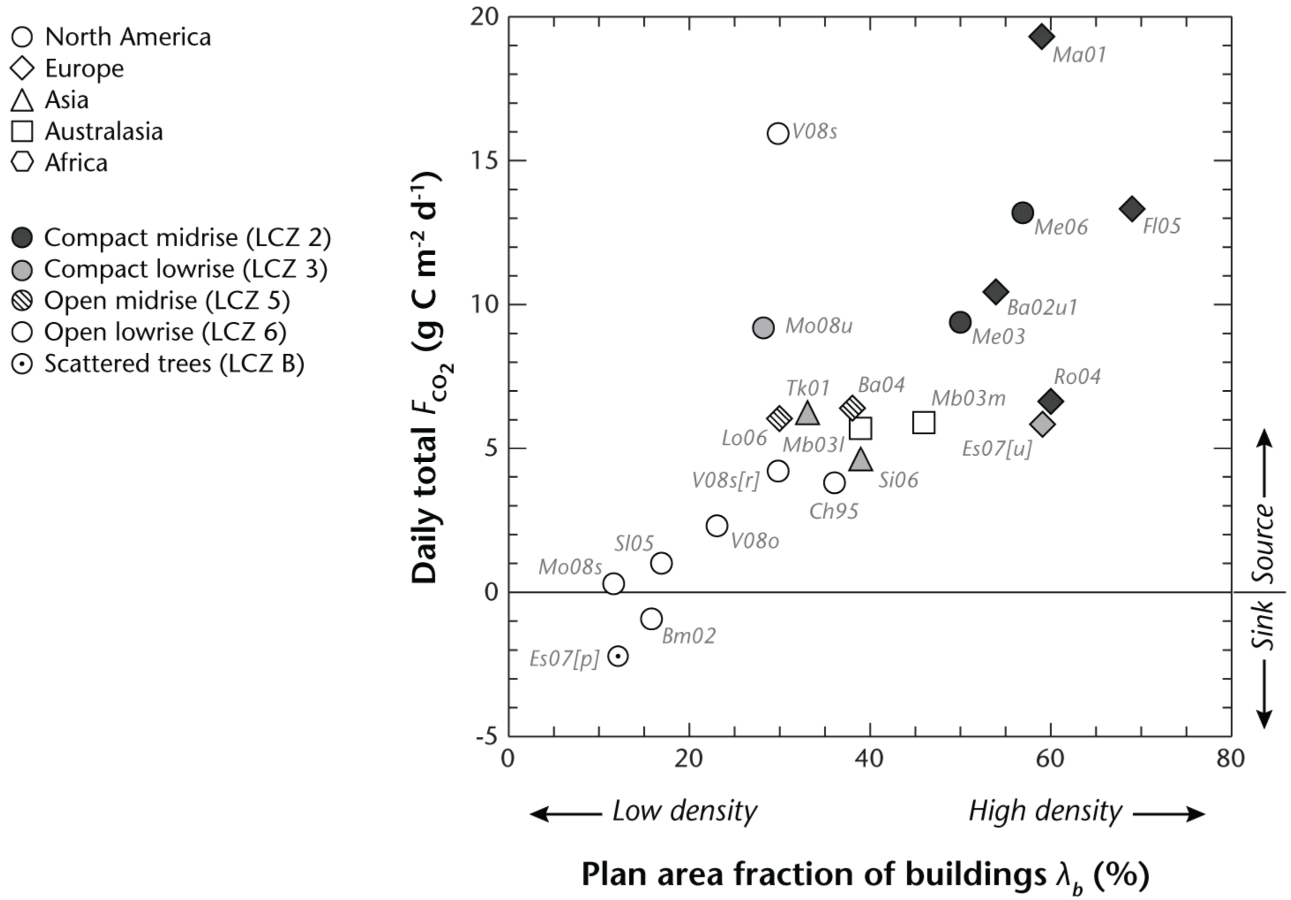
2c. Urban landscape descriptors

Models, which embody urban climate knowledge require descriptions of the urban landscape (urban canopy parameters) to simulate urban climate impacts. These models can allow us to transfer knowledge from one place to another and to project future climate impacts.

CANOPY UCPs	BUILDING UCPs	VEGETATION, OTHER UCPs
		Mean vegetation height
Mean canopy height	Mean Height	**Vegetation plan area density***
Canopy plan area density*	Std Dev of heights	**Vegetation top area density***
Canopy top area density*	Height histogram	**Vegetation frontal area density***
Canopy frontal area density*	Wall-to Plan area ratio	
Roughness Length	Height to width ratio	**Mean Orientation of Streets**
Displacement height	Plan area density*	Plan area fraction surface covers
Sky View Factor	Rooftop area density*	**% connected impervious areas**
	Frontal area density*	Building material fraction
*computed as a function of height (1-m increments)		

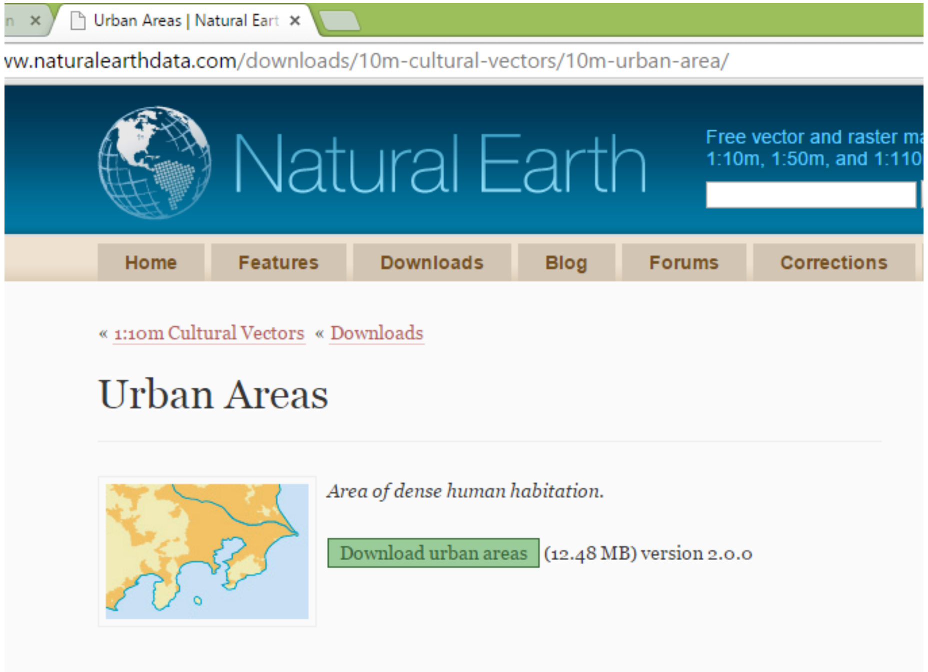
NUDAPT: Ching et al., BAMS 2009

Linking UCPs to urban climate effects



Measured averaged summertime F_{CO2} from 20 flux towers in urban environments vs. the plan area fraction of buildings. Site codes refer to the list of experimental sites compiled. (Based on Grimmond and Christen, 2012).

3. The Global Urban Knowledge Gap



Currently available global urban databases provide information on the limits of cities with no internal character. These data have limited value for climate studies.

Cities in the IPCC 5th Assessment Report AR5

Urban mitigation highlights key knowledge gaps including:

- There is little scientific understanding of the magnitude of the emissions reduction from altering urban form, and the emissions savings from integrated infrastructure and land use planning.
- There are few evaluations of urban climate action plans and their effectiveness.

Source: IPCC, 2014 AR5 III

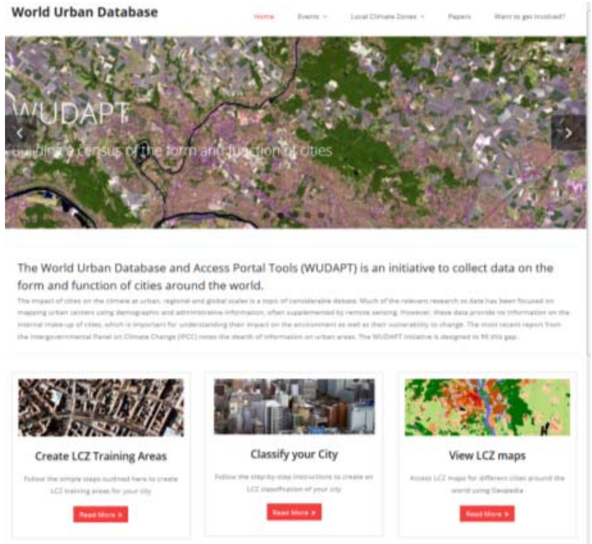
Urban adaptation identifies several key uncertainties and research priorities, including:

- the limits to understanding and predicting impacts of climate change at a fine grained geographic and sectoral scale;
- inadequate knowledge on the vulnerability of the built environment … to the direct and indirect impacts of climate change and of the most effective responses for new-build and for retrofitting;
- **serious limitations on geophysical, biological and socio-economic data needed for adaptation at all geographic scales**, including data on nature-society links and local (fine-scale) contexts and hazards.

Source: IPCC, 2014 AR5 II

WUDAPT World Urban Database and Access Portal Tools

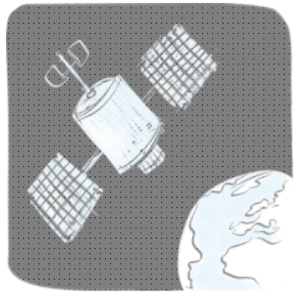
- **Knowledge about internal structure of urban areas** is **relevant for various applications** (urban climate, DRR, Sustainable Development Goals, energy, health, …) and currently often missing
- international collaborative project for the **acquisition, storage and dissemination of climate relevant data** on physical geographies of cities
- Aim: worldwide **physical census of cities** in different levels of detail by **crowdsourcing**
- **form** (surface cover, construction materials and geometry) **and function** (metabolism, i.e. exchange of energy, water and materials) of cities



http://www.wudapt.org

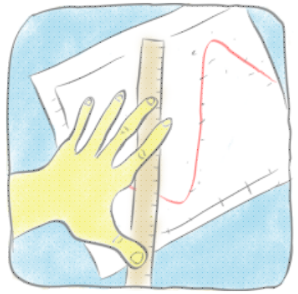
Level 2

- Detailed description of urban landscape parameters at a scale suited to boundary-layer models
- Use of all available databases (e.g. building footprints)



Level 1

- More precise parameter values for each LCZ
- Focus on aspects of form (e.g. building heights, street width) and functions (e.g. building use).
- Sampling of LCZ using GeoWiki



Level 0

- Local Climate Zones (LCZ) along with parameter ranges
- Categorise city neighbourhoods into LCZ types
- Local experts provide training areas
- GoogleEarth, Landsat8 and Saga

Fig. 1.WUDAPT's data hierarchy

Level 0

Level 0

- Local Climate Zones (LCZ) along with parameter ranges
- Categorise city neighbourhoods into LCZ types
- Local experts provide training areas
- GoogleEarth, Landsat8 and Saga

Level 0 WUDAPT data describes the urban landscape in terms of LCZ types, which are linked to ranges of urban canopy parameter (UCP) values.

- These maps can be used to compare urban landscapes in terms of their local climate effects (≥ 1 sq.km) and may provide guidance for the selection of UCP values for use in climate models.
- They may also be used to place weather stations in their local context (station metadata) and can be used to estimate the likely effect of the urban landscape on local air and surface temperatures.

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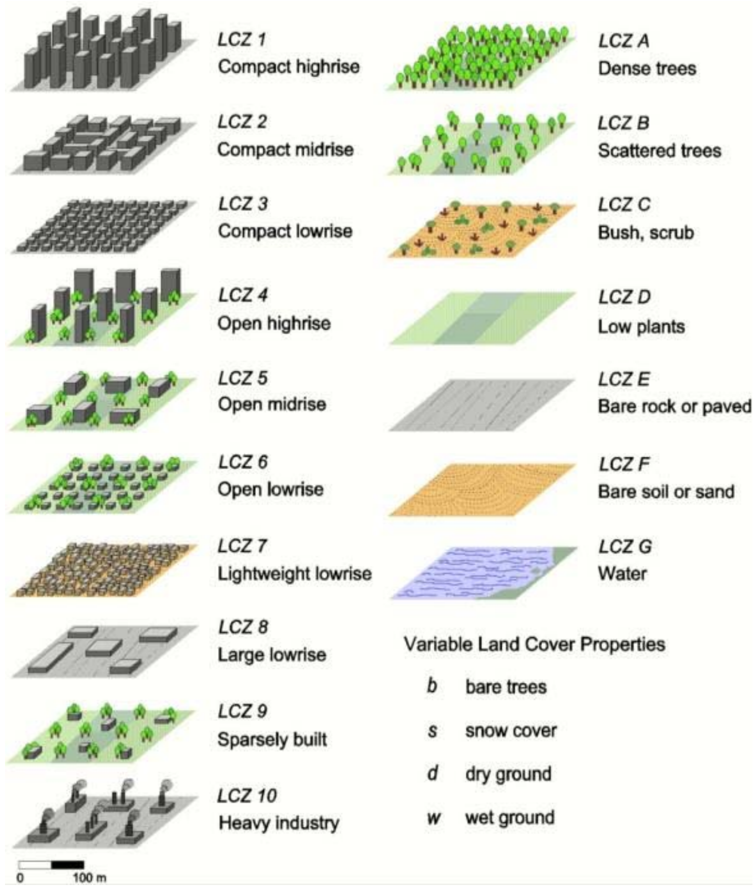
cen

Local Climate Zones (Stewart & Oke 2012)

- *regions of uniform surface cover, structure, material, and human activity that span hundreds of meters to several kilometers in horizontal scale*
- Origin urban climatology - characteristic screen-height air temperature regime
- but much wider scope - standardized physical description of cities
- Generic, no cultural bias
- Numerous geometric, thermal, radiative, metabolic, and surface cover properties

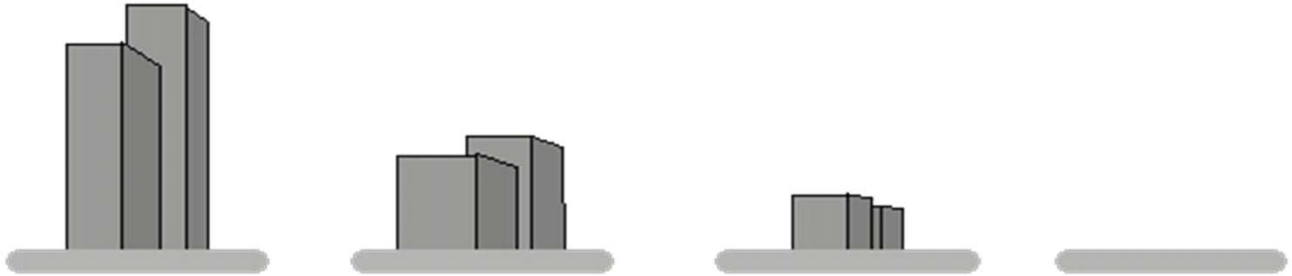


Stewart & Oke 2012

Constructing the LCZ Framework

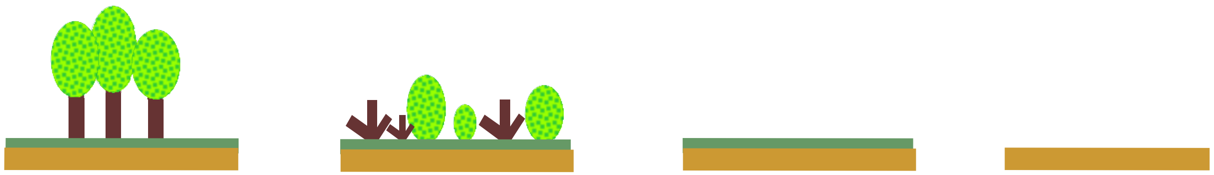
1. Height of roughness features

Buildings



highrise	midrise	lowrise	no rise
> 25 m	10-20 m	< 8 m	0 m

Vegetation

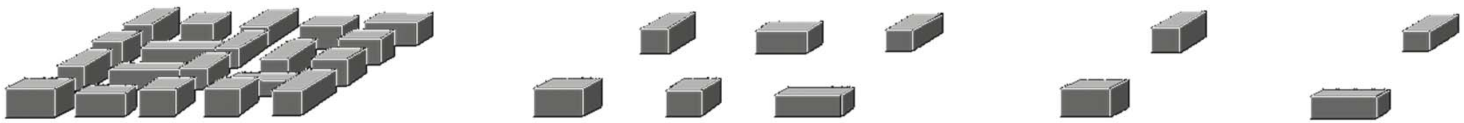


trees	bush	grasses	soil
> 3 m	1-2 m	< 1 m	0 m

Constructing the LCZ Framework

2. Packing of roughness features

Buildings



compact $\lambda_b > 40\ \%$

open $20\ \% < \lambda_b < 40\ \%$

sparse $10\ \% < \lambda_b < 20\ \%$

Vegetation

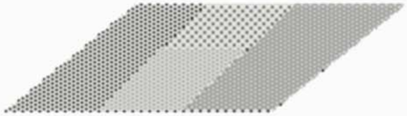
compact H/W > 1

open H/W 0.25 – 0.75

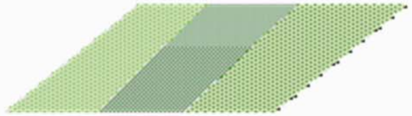
sparse H/W < 0.25

Constructing the LCZ Framework

3. Surface cover around roughness features



impervious
concrete/rock

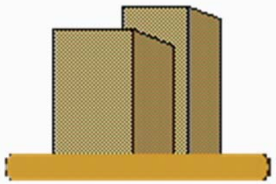


pervious
low plants

pervious
soils

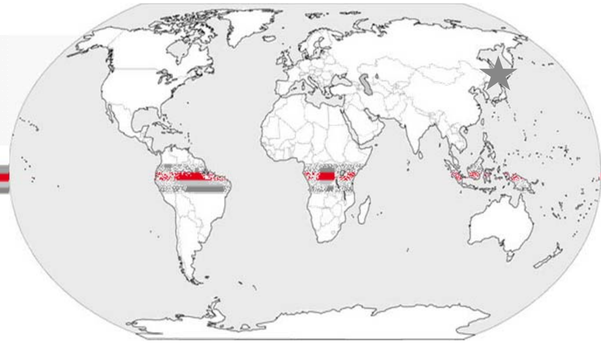
4. Thermal admittance of materials

heavy
concrete, stone



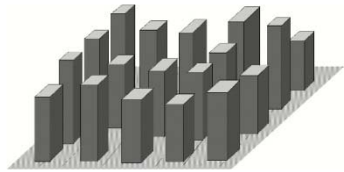
lightweight
sheet metal, wood

CLASSIFYING LCZs



Sendai, JAPAN

Diurnal temperature range: **small** medium large

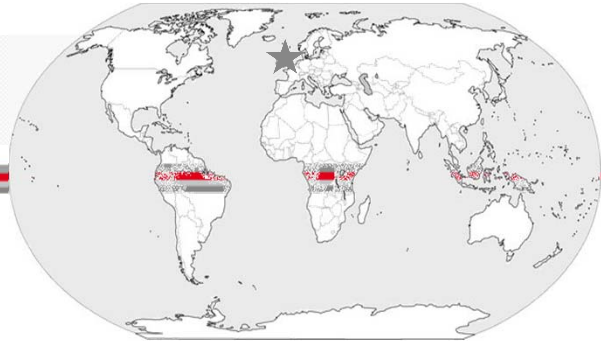


LCZ 1
Compact high-rise

<u>Visual Clues</u>

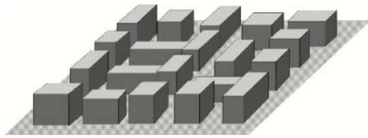
Few if any trees
Little or no green space
Tightly packed buildings
10^{+} stories tall

CLASSIFYING LCZs



London, UK

Diurnal temperature range: **small** medium large

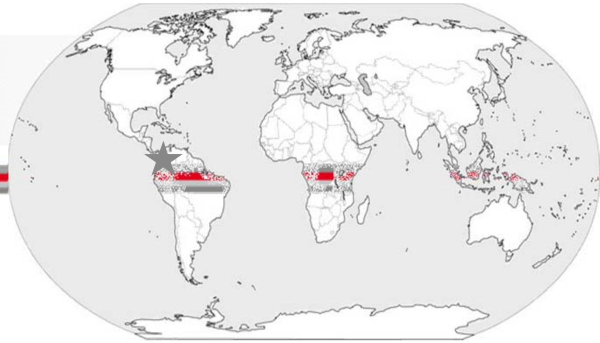


LCZ 2
Compact mid-rise

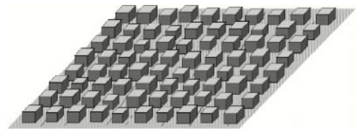
<u>Visual Clues</u>
Few if any trees
Little or no green space
Tightly packed buildings
3 – 9 stories tall

CLASSIFYING LCZs

Medellin, COLOMBIA



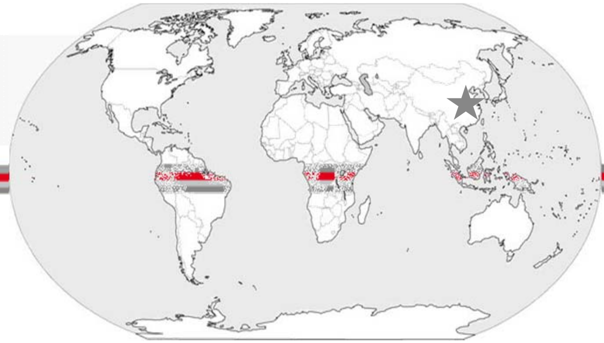
Diurnal temperature range:	small	**medium**	large



LCZ 3
Compact low-rise

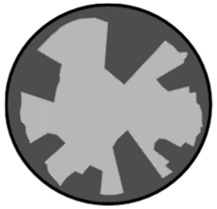
Visual Clues
Few if any trees
Little or no green space
Tightly packed buildings
1 – 3 stories tall

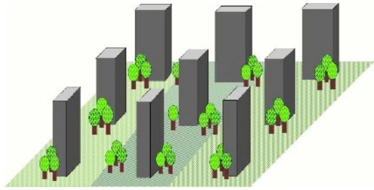
CLASSIFYING LCZs



Jinan, CHINA

Diurnal temperature range:	**low**	medium	high

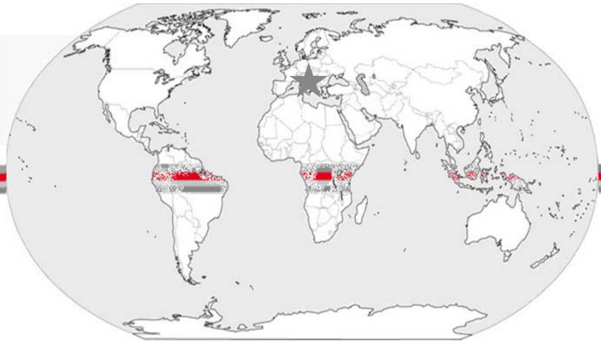




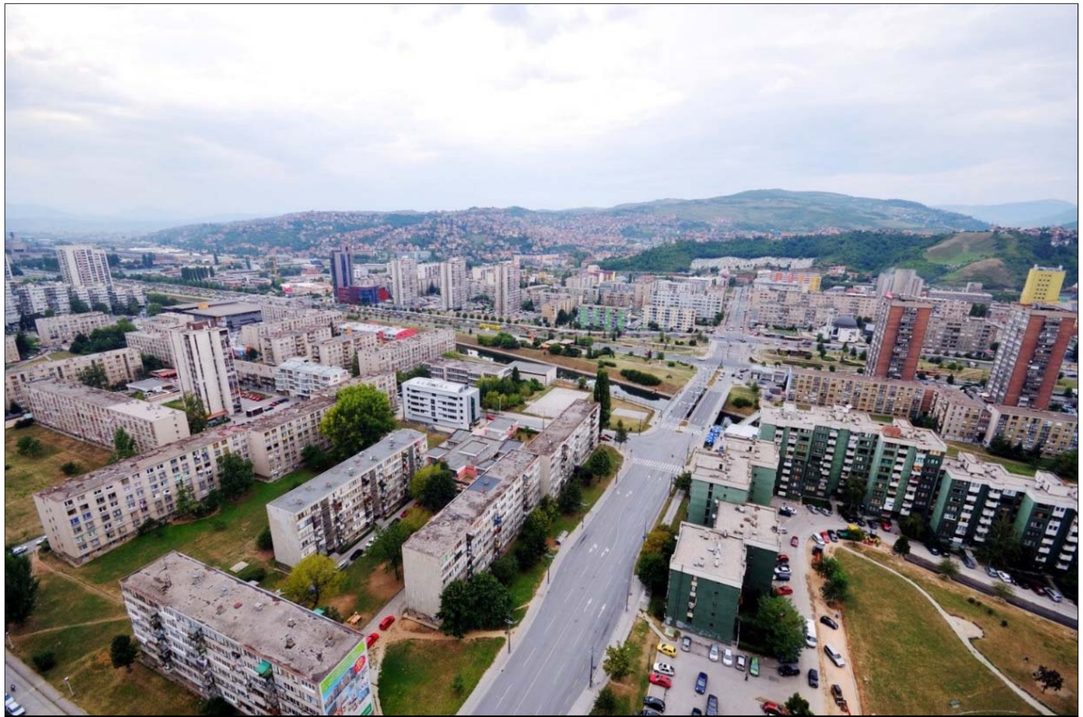
LCZ 4
Open high-rise

Visual Clues
Abundance of trees and pervious cover
Openly arranged buildings
10s of stories tall

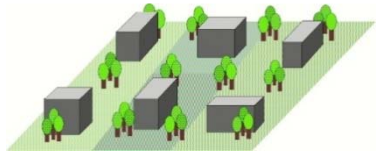
CLASSIFYING LCZs



Sarajevo, BOSNIA & HERZEGOVINA



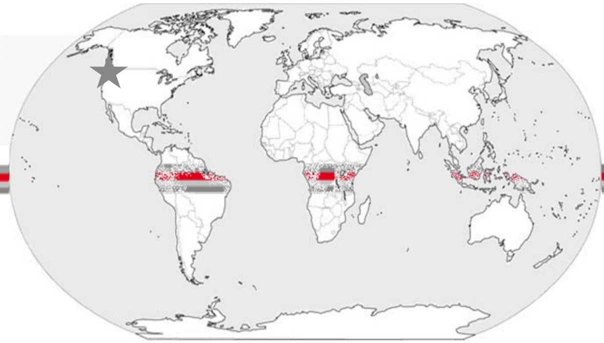
Diurnal temperature range: small **medium** large



LCZ 5
Open mid-rise

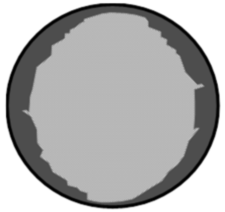
Visual Clues
Abundance of trees and pervious cover
Openly arranged buildings
3 – 9 stories tall

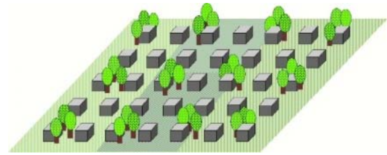
CLASSIFYING LCZs



Seattle, USA

Diurnal temperature range: small **medium** large



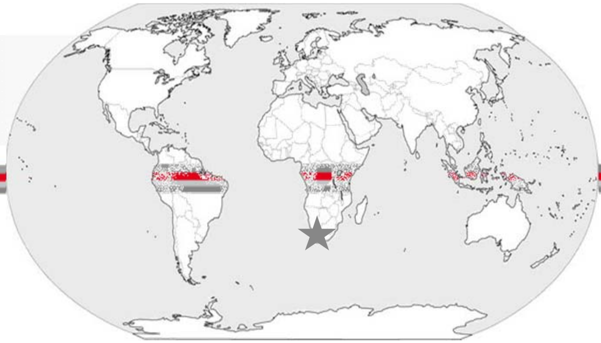


LCZ 6
Open low-rise

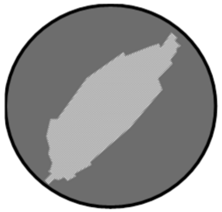
Visual Clues
Abundance of trees and pervious cover
Openly arranged buildings
1 – 3 stories tall

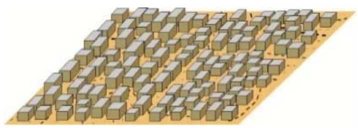
CLASSIFYING LCZs

Cape Town, SOUTH AFRICA



Diurnal temperature range:	small	medium	large

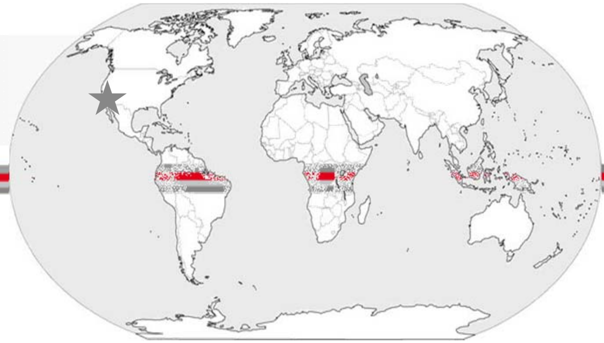




LCZ 7
Lightweight low-rise

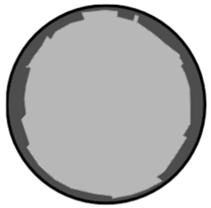
<u>Visual Clues</u>
Few or no trees
Land cover hard-packed
Lightweight building materials
1 – 2 stories tall

CLASSIFYING LCZs



Los Angeles, USA

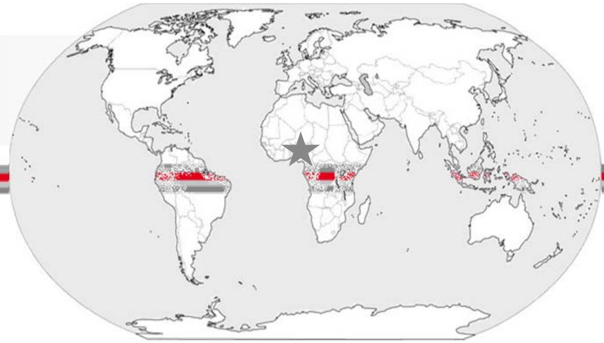
Diurnal temperature range:	small	**medium**	large



LCZ 8
Large low-rise

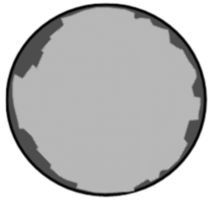
Visual Clues
Few if any trees
Land cover mostly paved
Large, openly arranged buildings, 1 – 3 stories tall

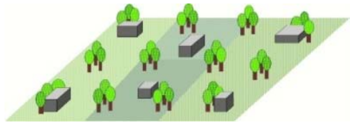
CLASSIFYING LCZs



Akure, NIGERIA

Diurnal temperature range:	small	medium	large





LCZ 9
Sparsely built

<u>Visual Clues</u>
Natural setting
Abundance of pervious cover
Sparse arrangement of small or mid-sized buildings

LCZ Type	SVF	Canyon Aspect Ratio (H/W)	Mean Height (m)	Terrain Roughness Class	Building Surface Fraction	Impervious Surface Fraction	Pervious Surface Fraction	Surface Albedo	QF (Wm^{-2})
1	0.2- 0.4	>2	>25	8	40-60%	40-60%	<10%	0.10-0.20	50-300
2	0.3-0.6	0.75-2	10-25	6-7	40-70%	30-50%	<20%	0.10-0.20	<75
3	0.2-0.6	0.75-1.5	3-10	6	40-70%	20-50%	<30%	0.10-0.20	<75
4	0.5-0.7	0.75-1.25	>25	7-8	20-40%	30-40%	30-40%	0.12-0.25	<50
5	0.5-0.8	0.3-0.75	10-25	5-6	20-40%	30-50%	20-40%	0.12-0.25	<25
6	0.6-0.9	0.3-0.75	3-10	5-6	20-40%	20-50%	30-60%	0.12-0.25	<25
7	0.2-0.5	1-2	2-4	4-5	60-90%	<20%	<30%	0.15-0.35	<35
8	>0.7	0.1-0.3	3-10	5	30-50%	40-50%	<20%	0.15-0.25	<50
9	>0.8	0.1-0.25	3-10	5-6	10-20%	<20%	60-80%	0.12-0.25	<10
10	0.6-0.9	0.2-0.5	5-15	5-6	20-30%	20-40%	40-50%	0.12-0.20	>300
A	<0.4	>1	3-30	8	<10%	<10%	>90%	0.10-0.20	0
B	0.5-0.8	0.25-0.75	3-15	5-6	<10%	<10%	>90%	0.15-0.25	0
C	0.7-0.9	0.25-1	<2	4-5	<10%	<10%	>90%	0.15-0.30	0
D	>0.9	<0.1	1	3-4	<10%	<10%	>90%	0.15-0.25	0
E	>0.9	<0.1	<0.25	1-2	<10%	>90%	<10%	0.15-0.30	0
F	>0.9	<0.1	<0.25	1-2	<10%	<10%	>90%	0.20-0.35	0
G	>0.9	<0.1	N/A	1	<10%	<10%	>90%	0.02-0.10	0

Each LCZ type is associated with typical urban canopy parameter values

WUDAPT Objectives

1. Acquire information on aspects of form and functions of cities relevant to climate studies.
2. Database: Store the data in a geographic framework that is searchable and widely accessible.
3. Portal: Build tools to extract parameters and analyse urban properties for cross-urban comparison and model building.

Level 2

- Detailed description of urban landscape parameters at a scale suited to boundary-layer models
- Use of all available databases (e.g. building footprints)

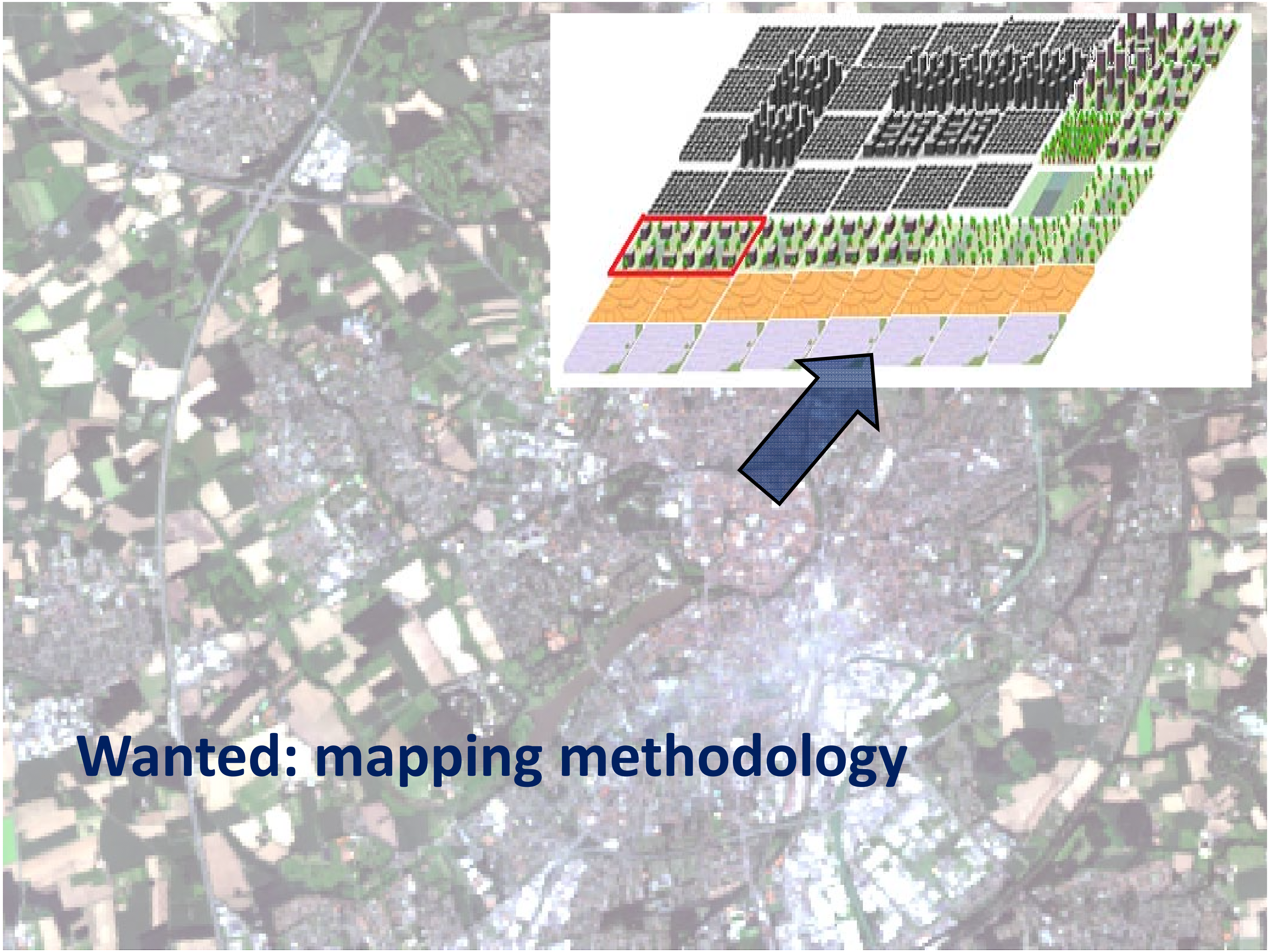
Level 1

- More precise parameter values for each LCZ
- Focus on aspects of form (e.g. building heights, street width) and functions (e.g. building use).
- Sampling of LCZ using GeoWiki

Level 0

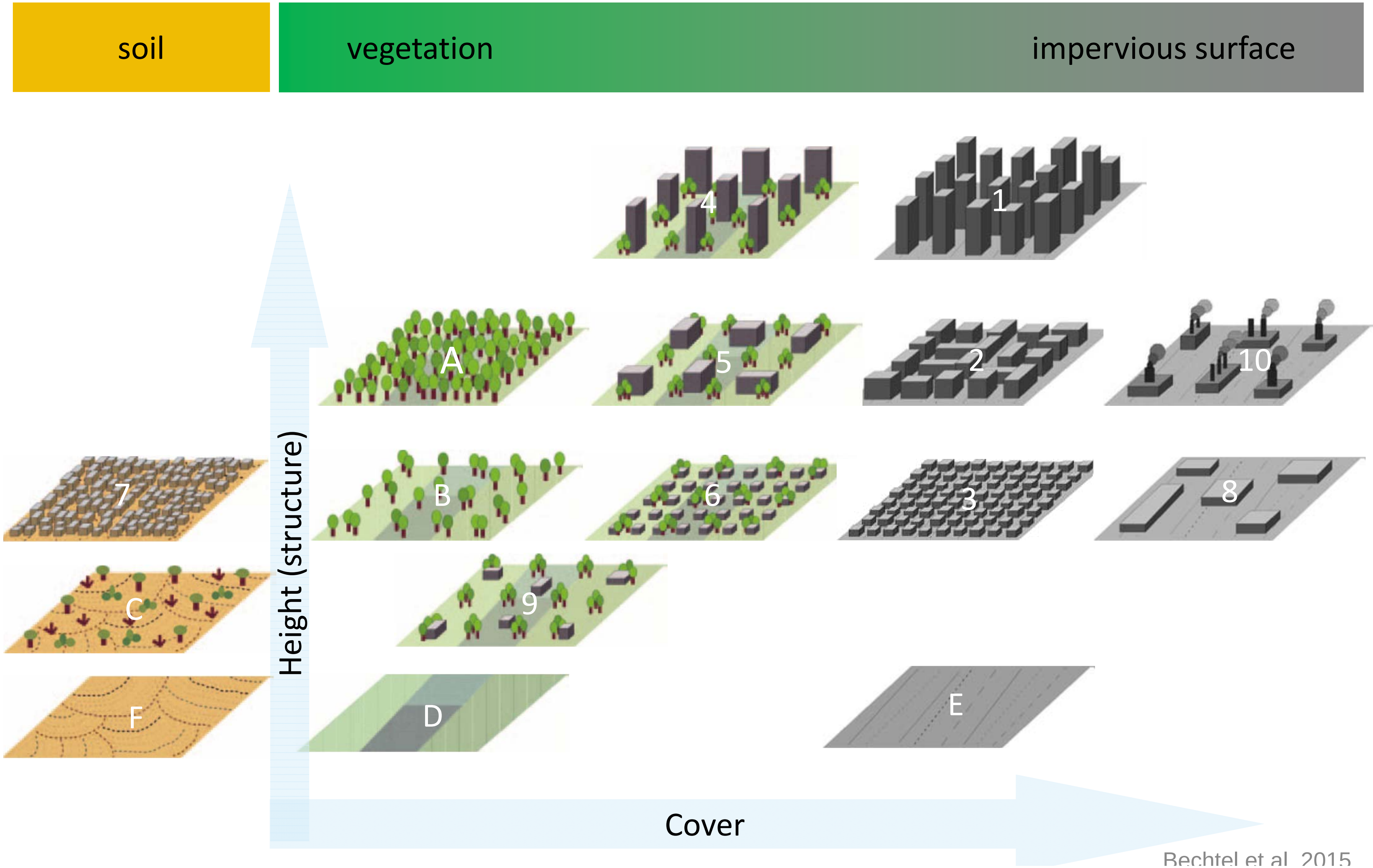
- Local Climate Zones (LCZ) along with parameter ranges
- Categorise city neighbourhoods into LCZ types
- Local experts provide training areas
- GoogleEarth, Landsat8 and Saga

The acquisition of data in WUDAPT will follow a hierarchical scheme, which reflects the potential (un)availability of data.



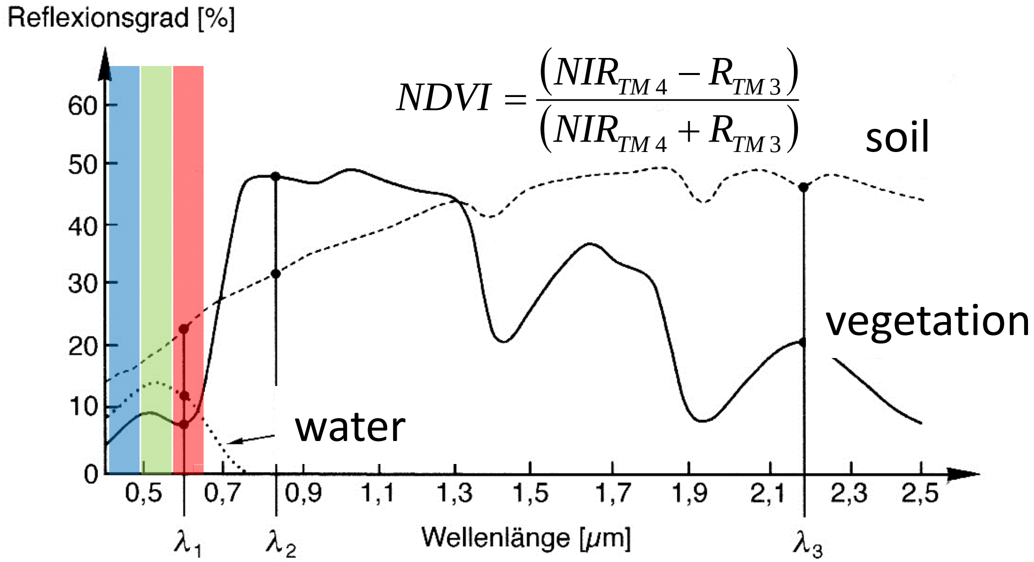
Wanted: mapping methodology

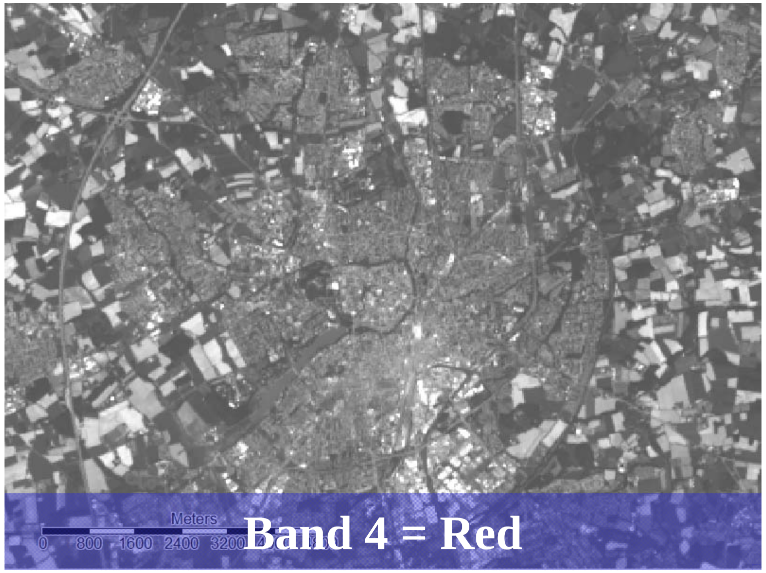
Remote sensing features

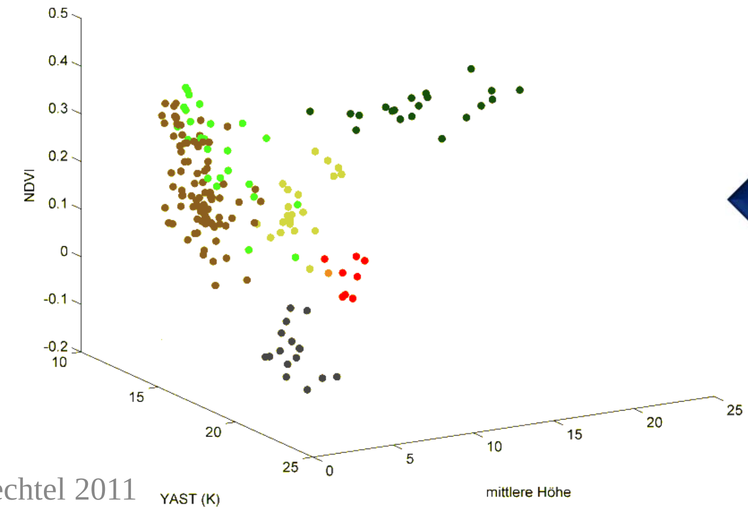


Bechtel et al. 2015

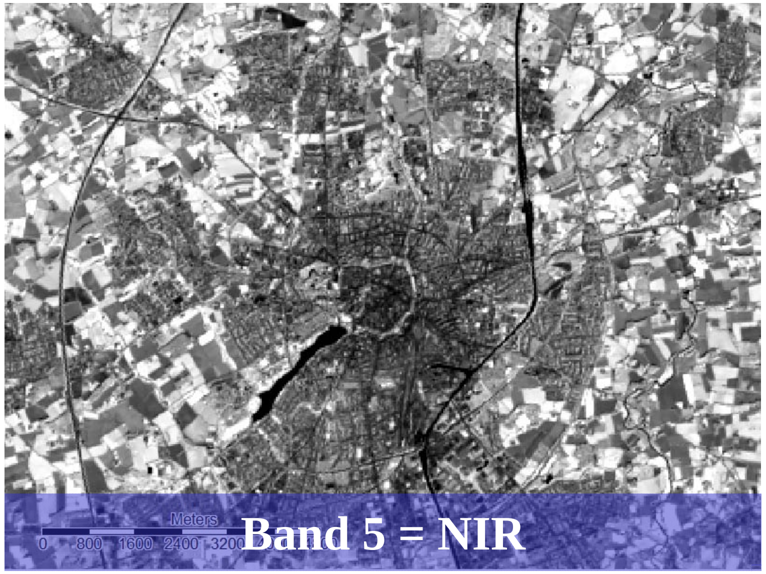
Spectral signature



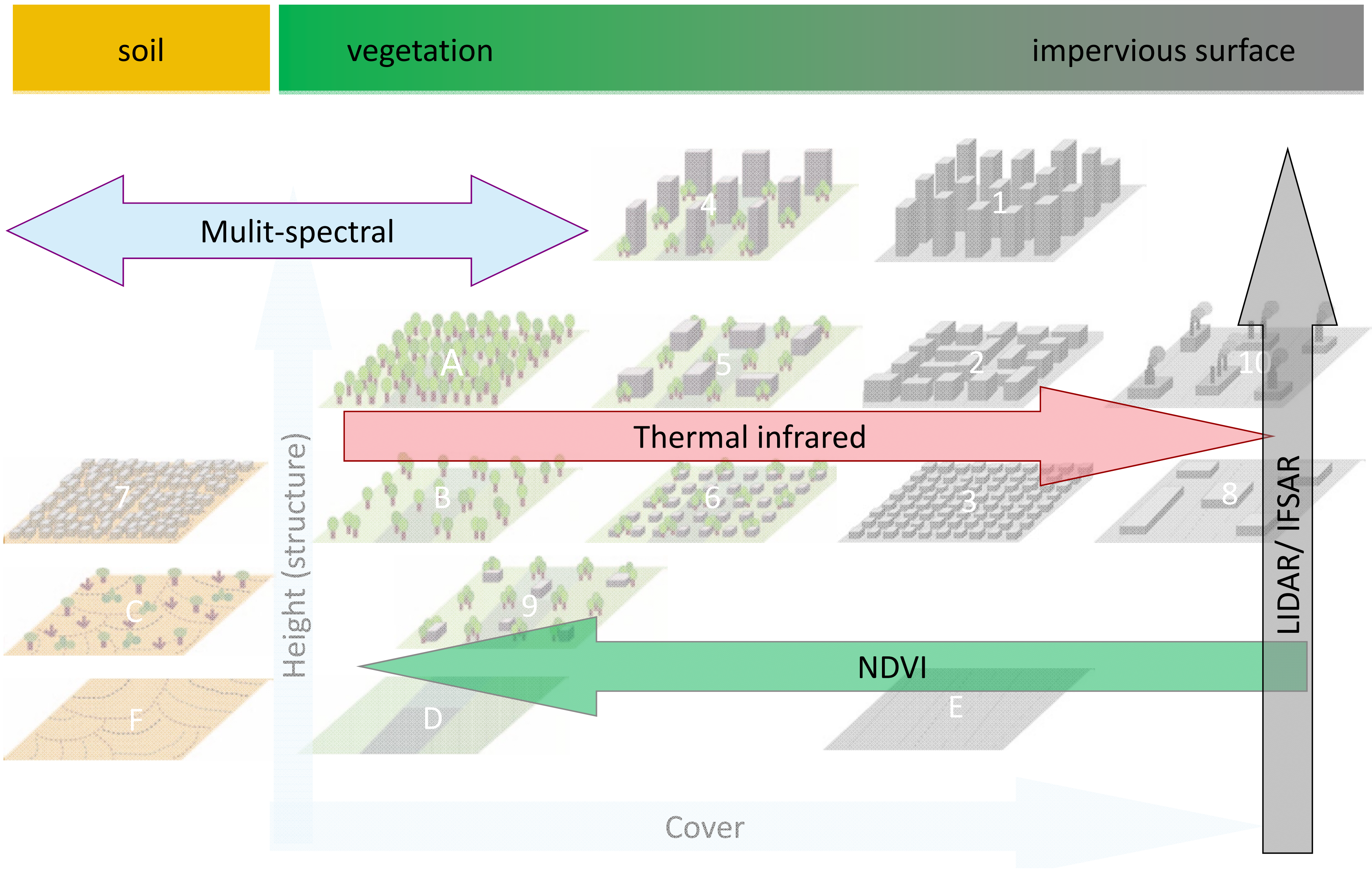




Bechtel 2011



Remote sensing features



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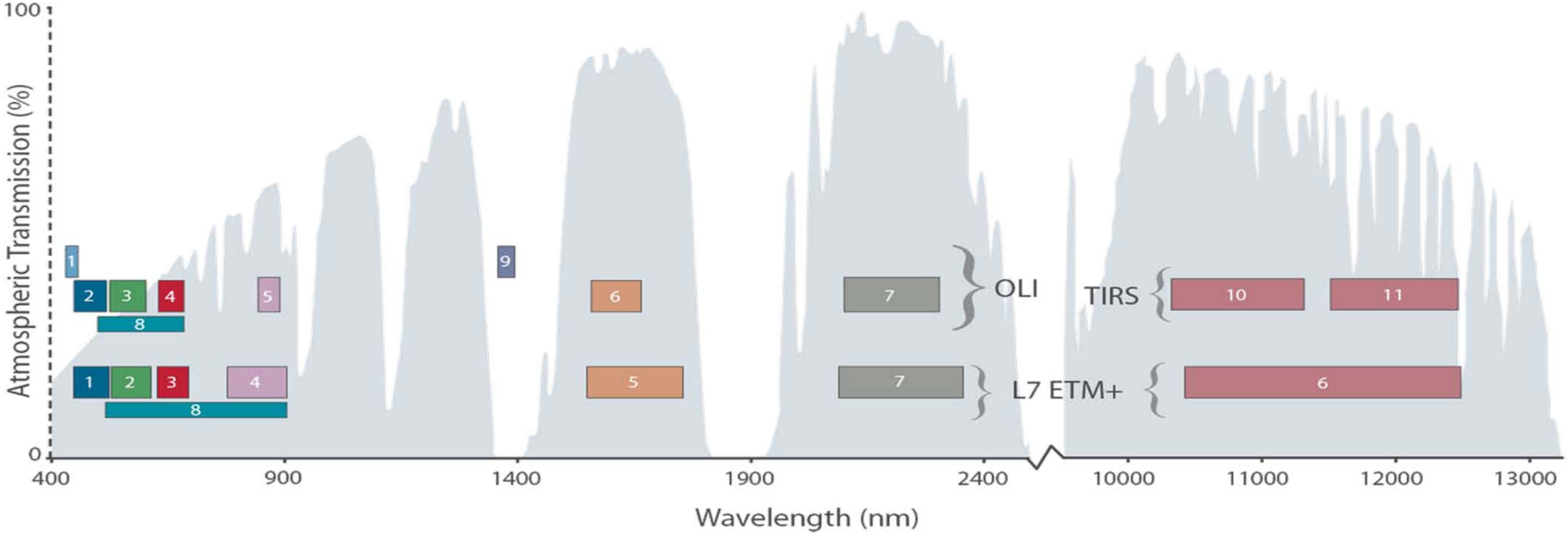
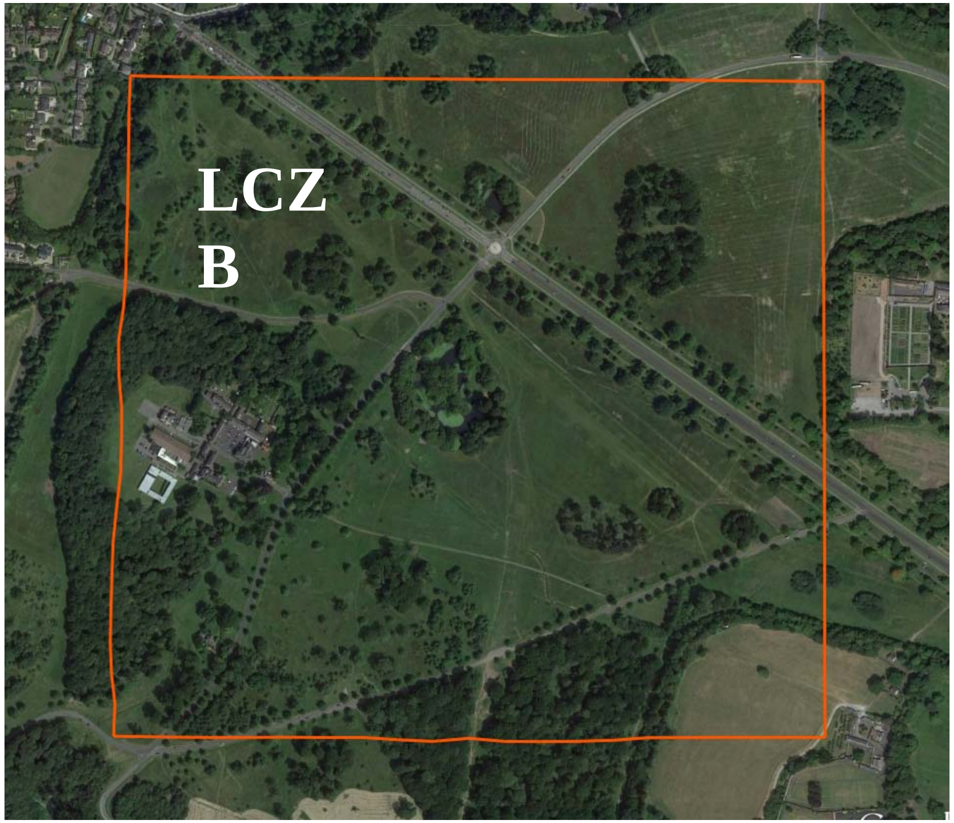
WH: Spektrale & räumliche Auflösung | Landsat 8



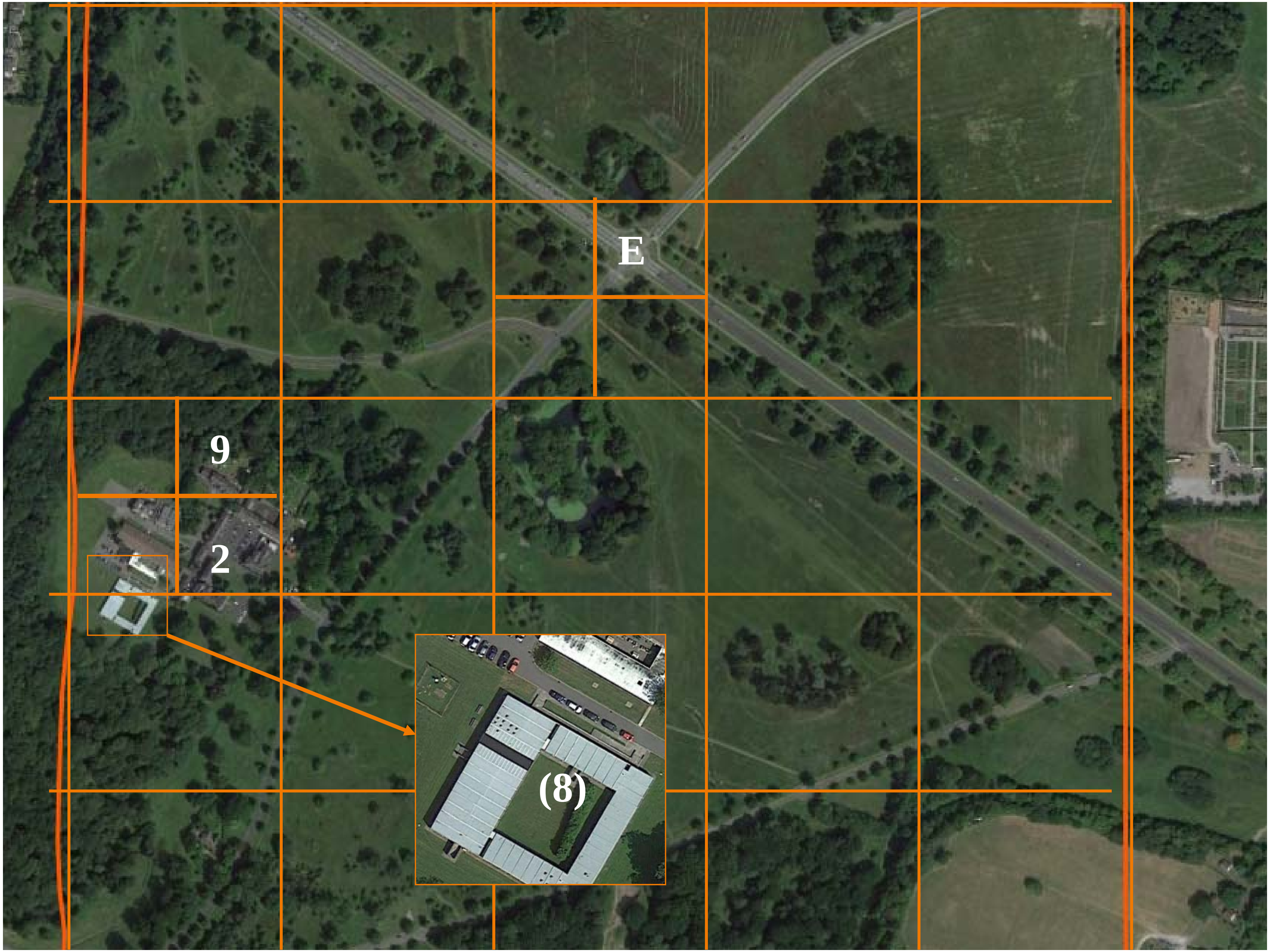
Satellit	Sensor	Spektralbereich	Bänder	Auflösung
L 1-4	MSS multi-spectral	0.5 - 1.1 µm	1, 2, 3, 4	60 meter
L 4-5	TM multi-spectral	0.45 - 2.35 µm	1, 2, 3, 4, 5, 7	30 meter
L 4-5	TM thermal	10.40 - 12.50 µm	6	120 meter

Satellit	Sensor	Spektralbereich	Bänder	Auflösung
L 7	ETM+ thermal	10.40 – 12.50 µm	6.1, 6.2	60 meter
L 7	Panchromatic	0.52-0.90 µm	8	15 meter
L8	OLI	0.433 - 2.300 µm	9	30 meter
L8	TIRS	10.30 – 11.30 µm	2	100 meter

USGS
science for a changing world

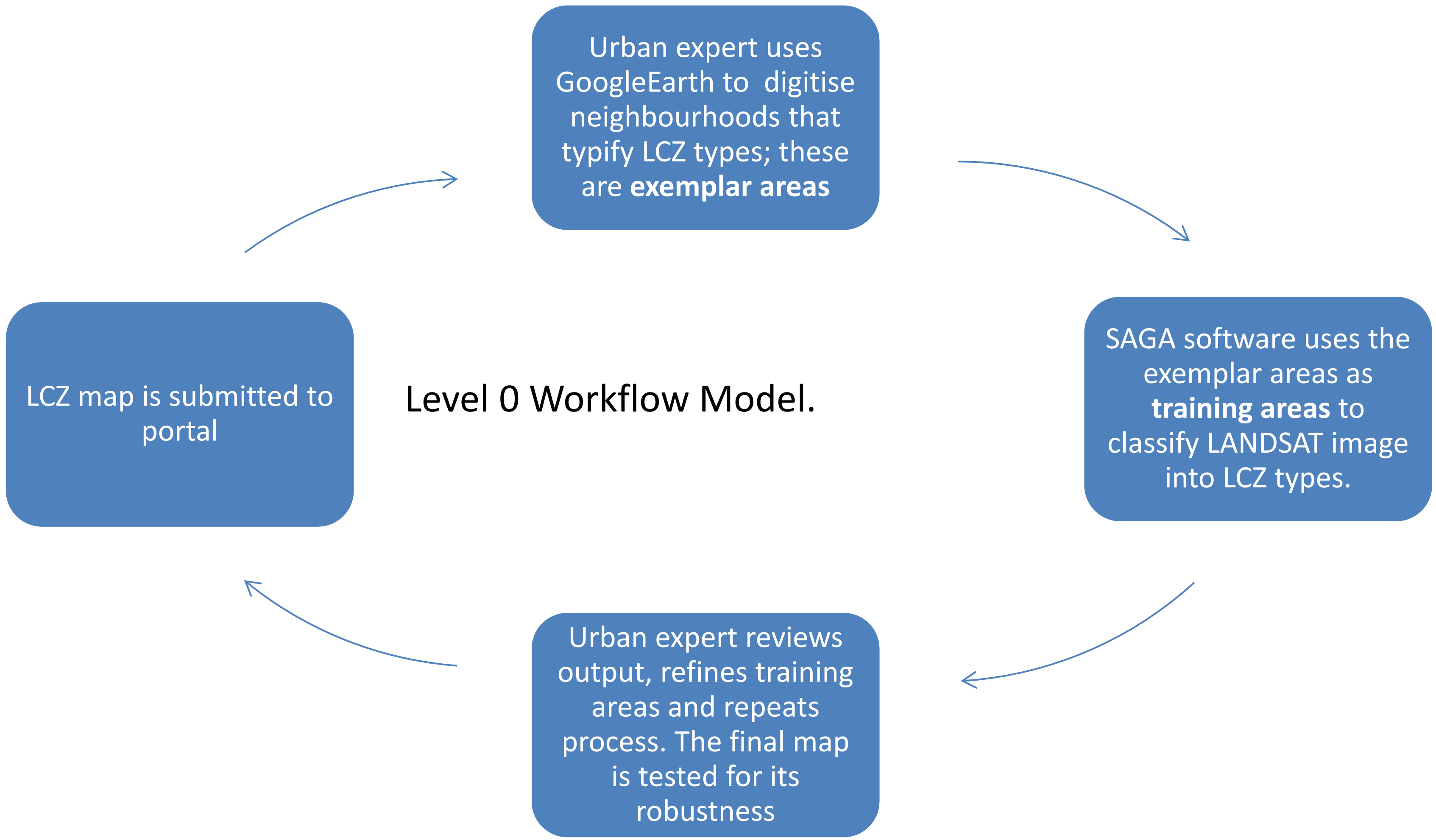


Phoenix park, Dublin



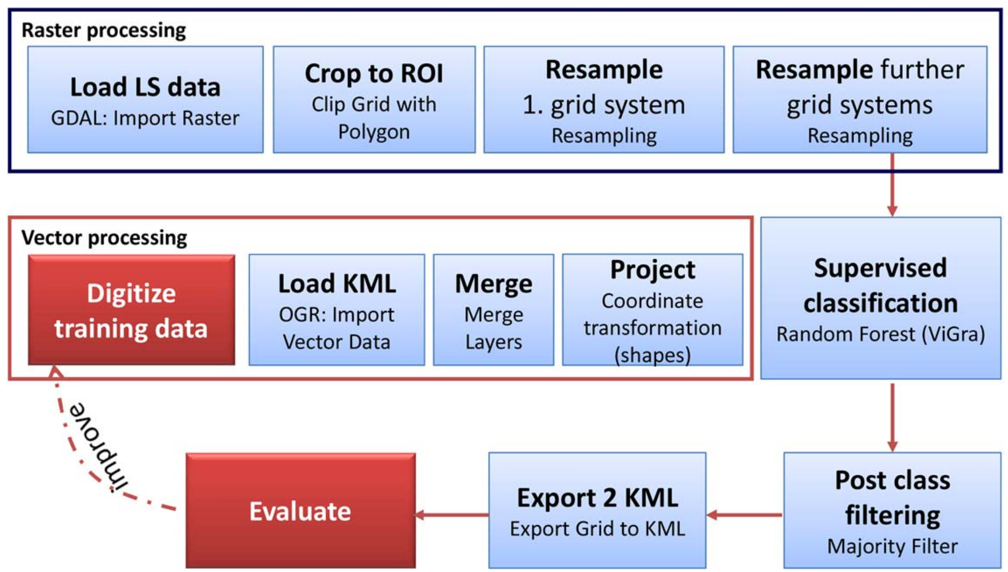
E
9
2
(8)

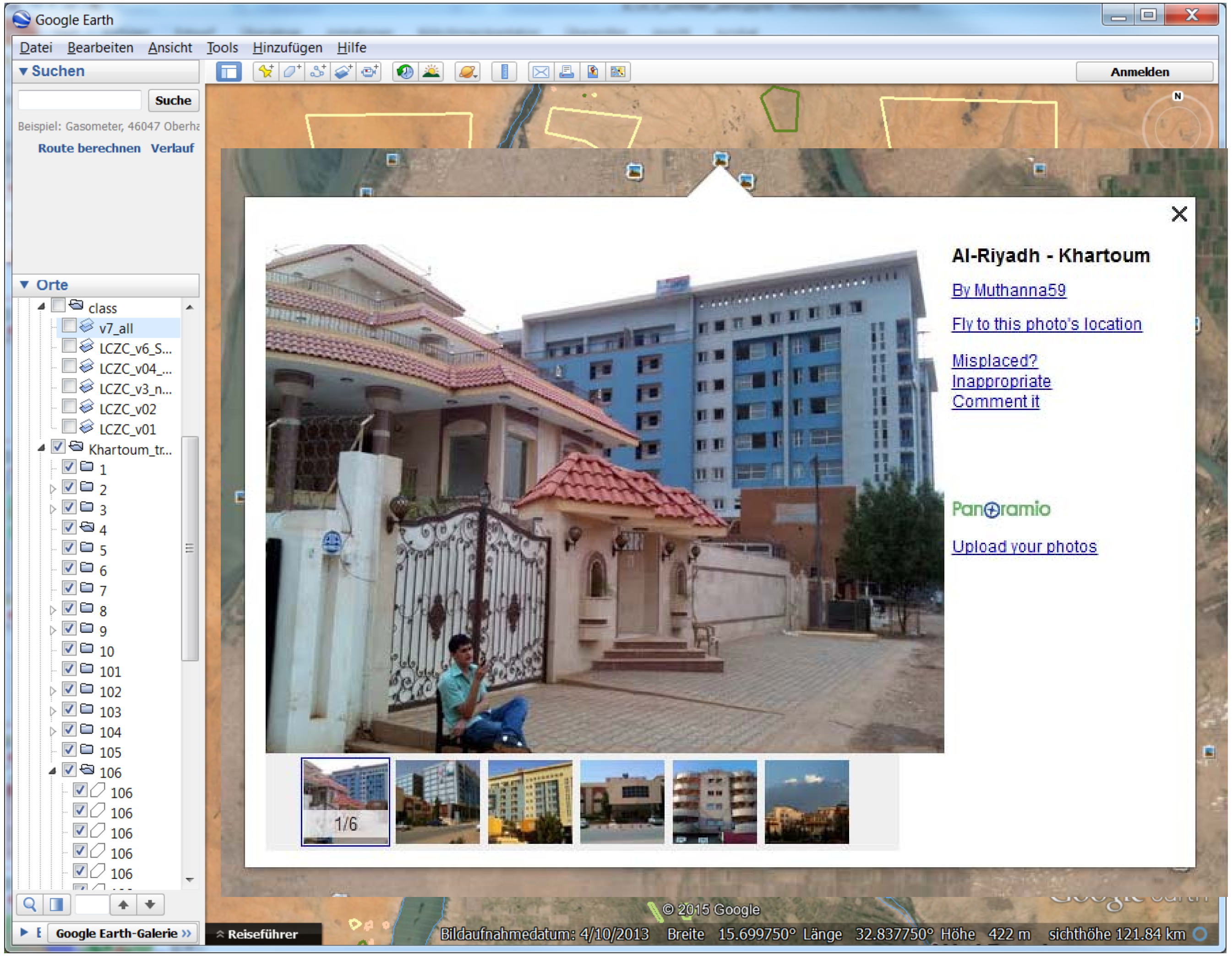
City area is identified & LANDSAT scenes compiled



USGS
science for a changing world

workflow

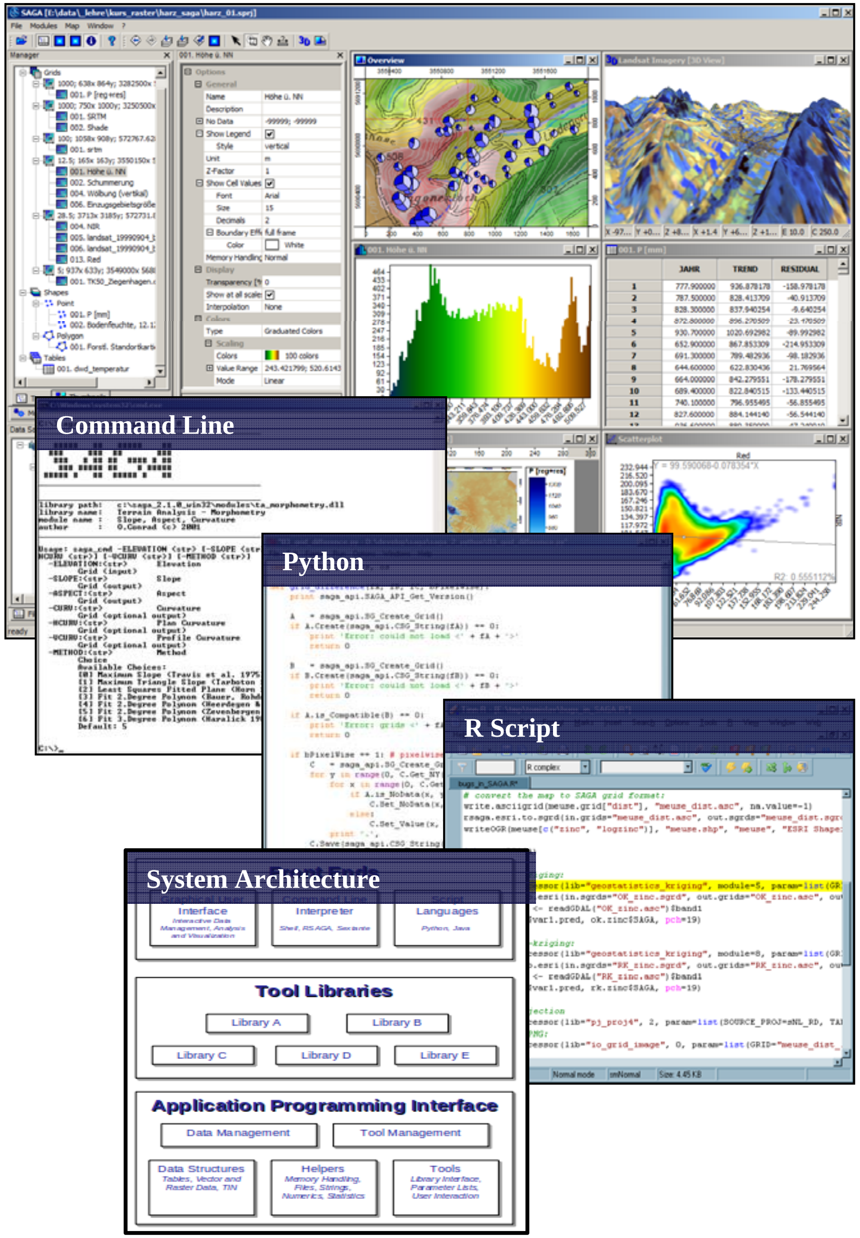



Google Earth
Datei Bearbeiten Ansicht Tools Hinzufügen Hilfe
Suchen
Suche
Beispiel: Gasometer, 46047 Oberha
Route berechnen Verlauf
Anmelden
Orte
class
v7_all
LCZC_v6_S...
LCZC_v04_...
LCZC_v3_n...
LCZC_v02
LCZC_v01
Khartoum_tr...
1
2
3
4
5
6
7
8
9
10
101
102
103
104
105
106
106
106
106
106
106
Al-Riyadh - Khartoum
By Muthanna59
Fly to this photo's location
Misplaced?
Inappropriate
Comment it
Panoramio
Upload your photos
1/6
Google Earth-Galerie
Reiseführer
© 2015 Google
Bildaufnahmedatum: 4/10/2013 Breite 15.699750° Länge 32.837750° Höhe 422 m sichthöhe 121.84 km

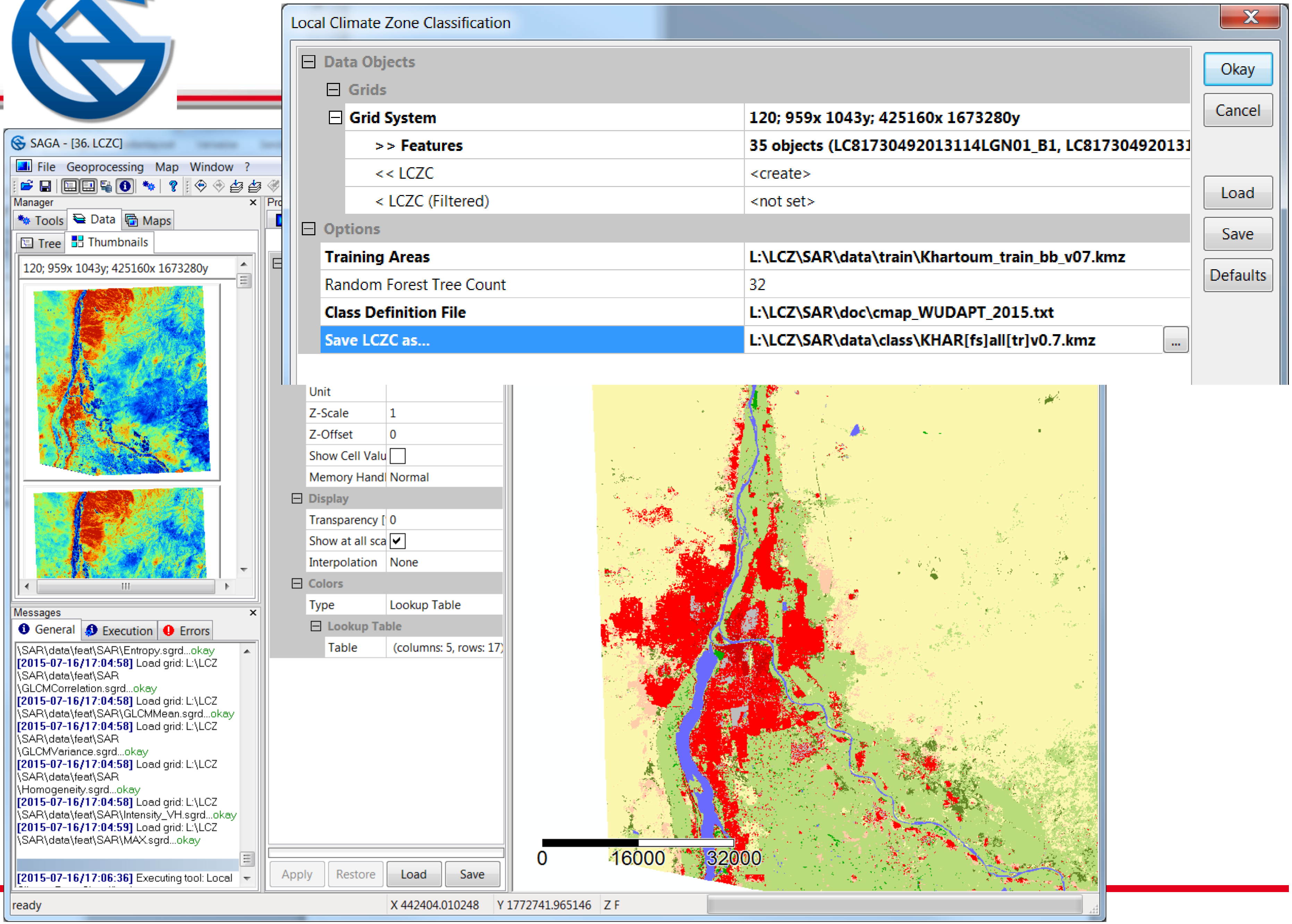
Khartoum

Key Features

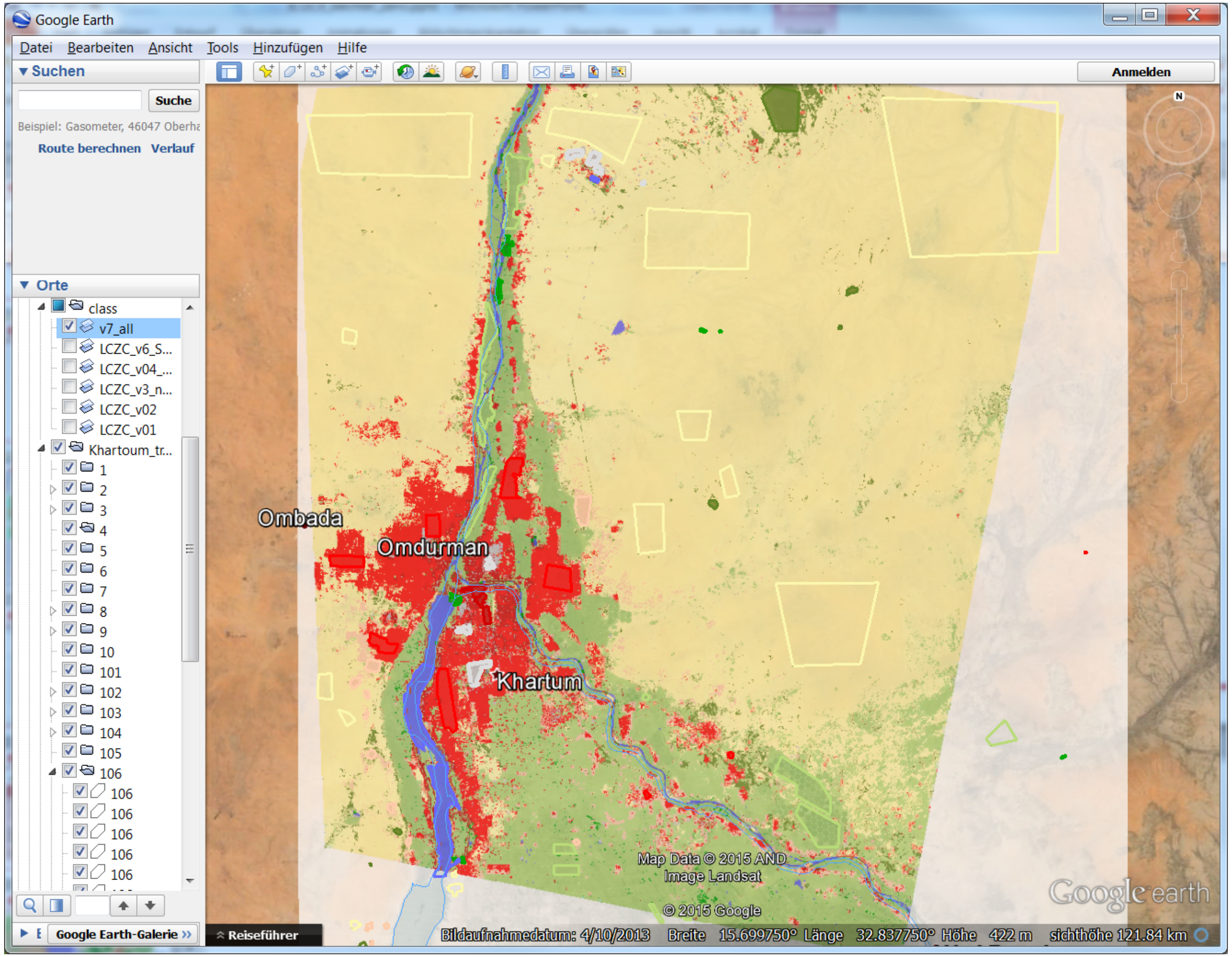
SAGA
System for Automated Geoscientific Analyses



- Object oriented system design
- **Modular structure** with framework independent tool development
- **API** with strong support for geodata handling
- **GUI** for intuitive data management, analysis and visualization
- Far **more than 650 free tools**
- Runs on Linux & Windows
- Portable software runs without installation even from USB sticks
- Free and **Open Source** Software
- 10 years of continuous development



Local Climate Zone Classification
Data Objects
Grids
Grid System
120; 959x 1043y; 425160x 1673280y
>> Features
35 objects (LC81730492013114LGN01_B1, LC817304920131
<< LCZC
<create>
< LCZC (Filtered)
<not set>
Options
Training Areas
L:\LCZ\SAR\data\train\Khartoum_train_bb_v07.kmz
Random Forest Tree Count
32
Class Definition File
L:\LCZ\SAR\doc\cmap_WUDAPT_2015.txt
Save LCZC as...
L:\LCZ\SAR\data\class\KHAR[fs]all[tr]v0.7.kmz
Okay
Cancel
Load
Save
Defaults
SAGA - [36. LCZC]
File Geoprocessing Map Window ?
Manager
Tools Data Maps
Tree Thumbnails
120; 959x 1043y; 425160x 1673280y
Messages
General Execution Errors
\SAR\data\feat\SAR\Entropy.sgrd...okay
[2015-07-16/17:04:58] Load grid: L:\LCZ \SAR\data\feat\SAR \GLCMCorrelation.sgrd...okay
[2015-07-16/17:04:58] Load grid: L:\LCZ \SAR\data\feat\SAR\GLCMMean.sgrd...okay
[2015-07-16/17:04:58] Load grid: L:\LCZ \SAR\data\feat\SAR \GLCMVariance.sgrd...okay
[2015-07-16/17:04:58] Load grid: L:\LCZ \SAR\data\feat\SAR \Homogeneity.sgrd...okay
[2015-07-16/17:04:58] Load grid: L:\LCZ \SAR\data\feat\SAR\Intensity_VH.sgrd...okay
[2015-07-16/17:04:59] Load grid: L:\LCZ \SAR\data\feat\SAR\MAX.sgrd...okay
[2015-07-16/17:06:36] Executing tool: Local
Unit
Z-Scale 1
Z-Offset 0
Show Cell Valu
Memory Handl Normal
Display
Transparency [0
Show at all sca
Interpolation None
Colors
Type Lookup Table
Lookup Table
Table (columns: 5, rows: 17)
Apply Restore Load Save
0 16000 32000
ready
X 442404.010248 Y 1772741.965146 Z F


Google Earth
Datei Bearbeiten Ansicht Tools Hinzufügen Hilfe
Suchen
Suche
Beispiel: Gasometer, 46047 Oberha
Route berechnen Verlauf
Anmelden
Orte
class
v7_all
LCZC_v6_S...
LCZC_v04_...
LCZC_v3_n...
LCZC_v02
LCZC_v01
Khartoum_tr...
1
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3
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102
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Google Earth-Galerie
Reiseführer
Ombada
Omdurman
Khartum
Map Data © 2015 AND
Image Landsat
© 2015 Google
Google earth
Bildaufnahmedatum: 4/10/2013 Breite 15.699750° Länge 32.837750° Höhe 422 m sichthöhe 121.84 km

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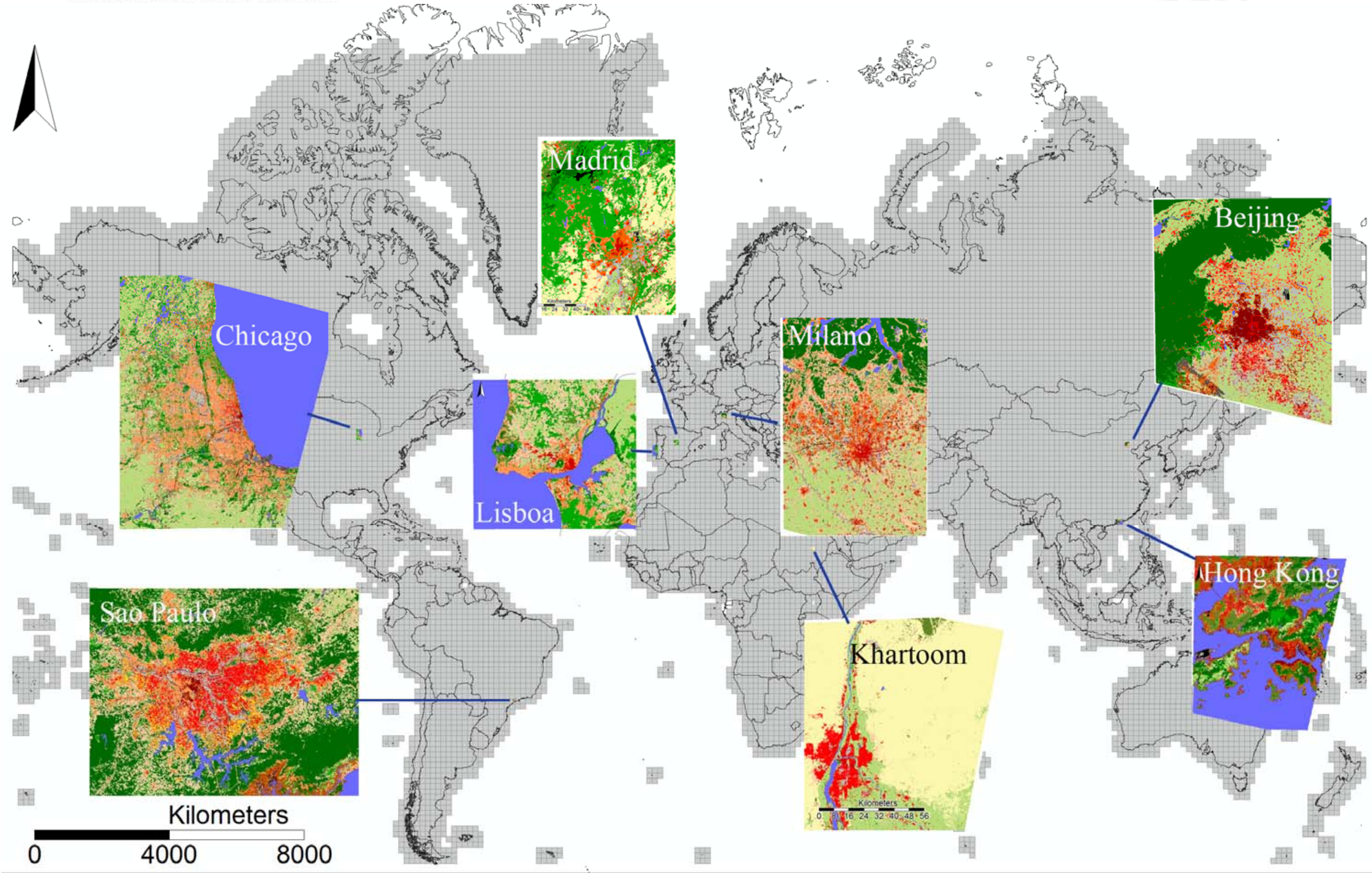
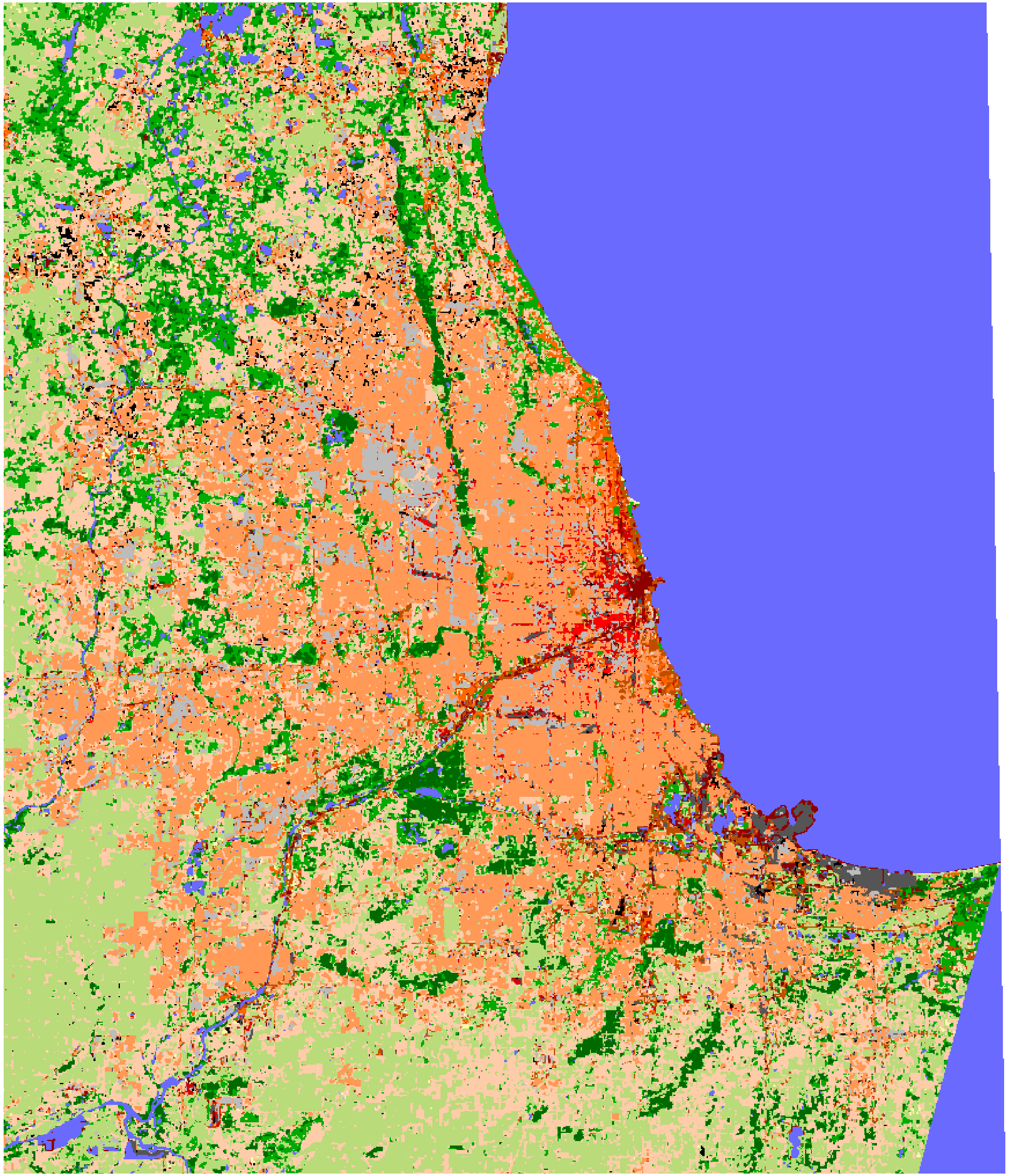
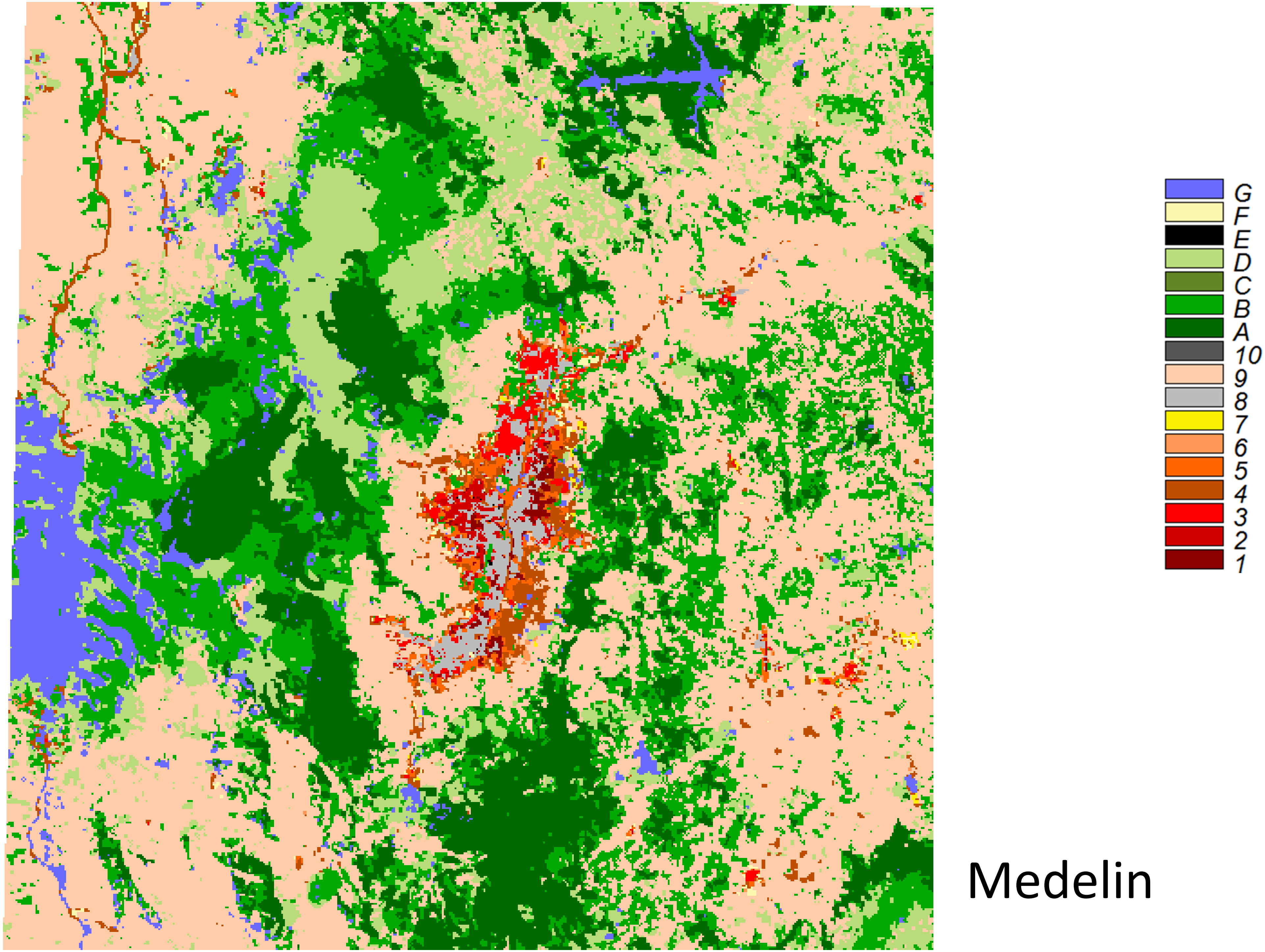
cen



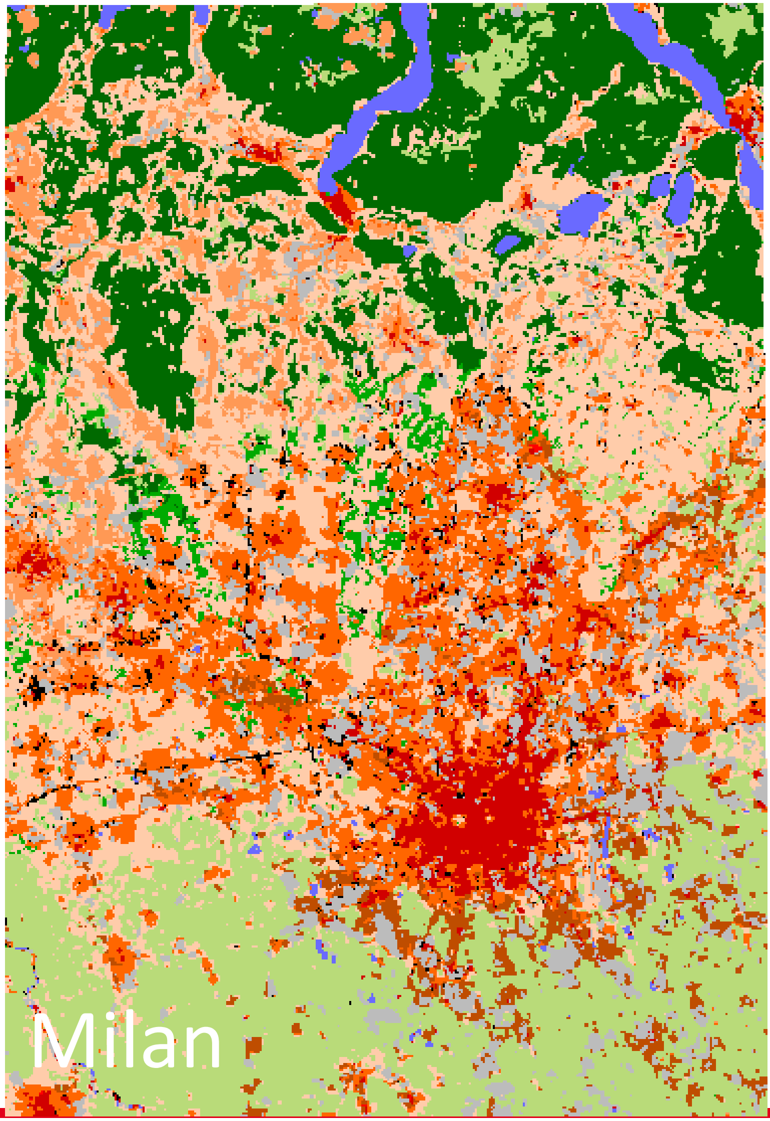
Bechtel et al. 2016. in press

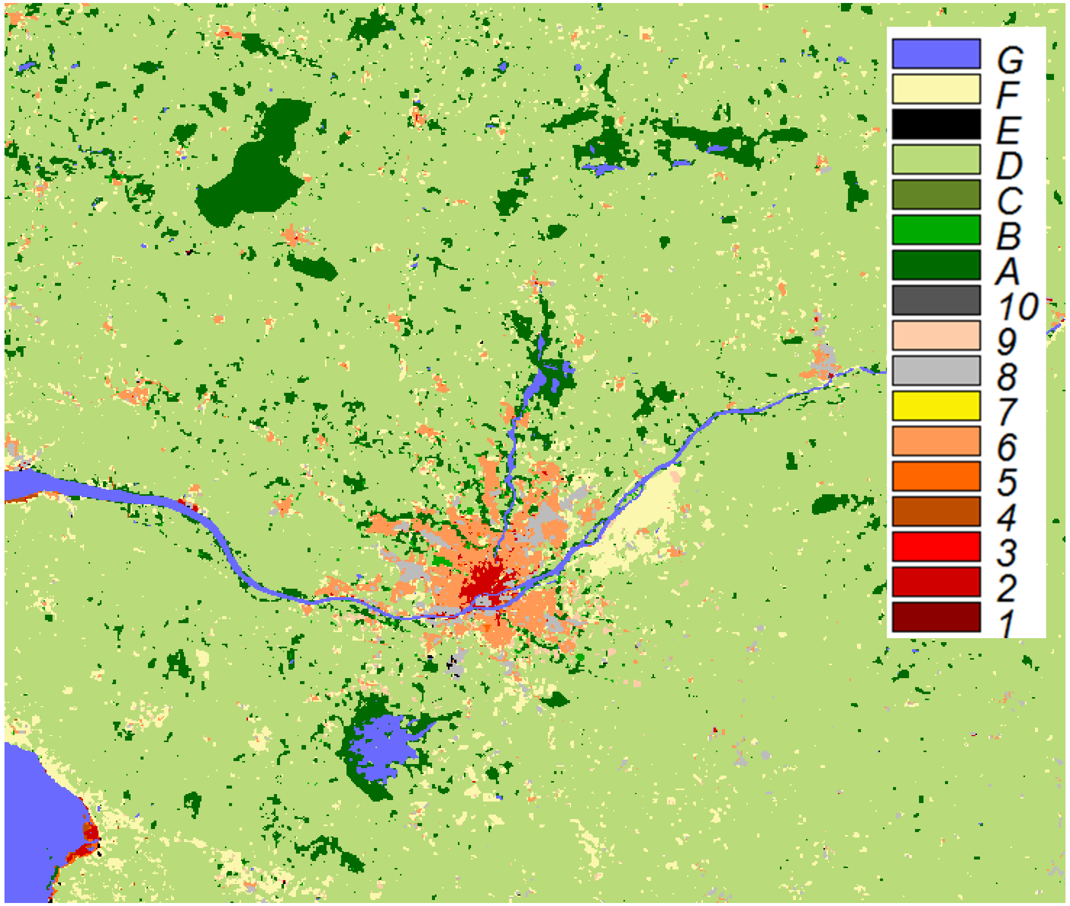
Chicago


WUDAPT Color Scheme
Water
Bare Soil or Sand
Bare Rock or Paved
Low Plants
Bush, Scrub
Scattered Trees
Dense Trees
Heavy Industry
Sparselt Built
Large Low-Rise
Lightweight Low-Rise
Open Low-Rise
Open Mid-Rise
Open High-Rise
Compact Low-Rise
Compact Mid-Rise
Compact High-Rise

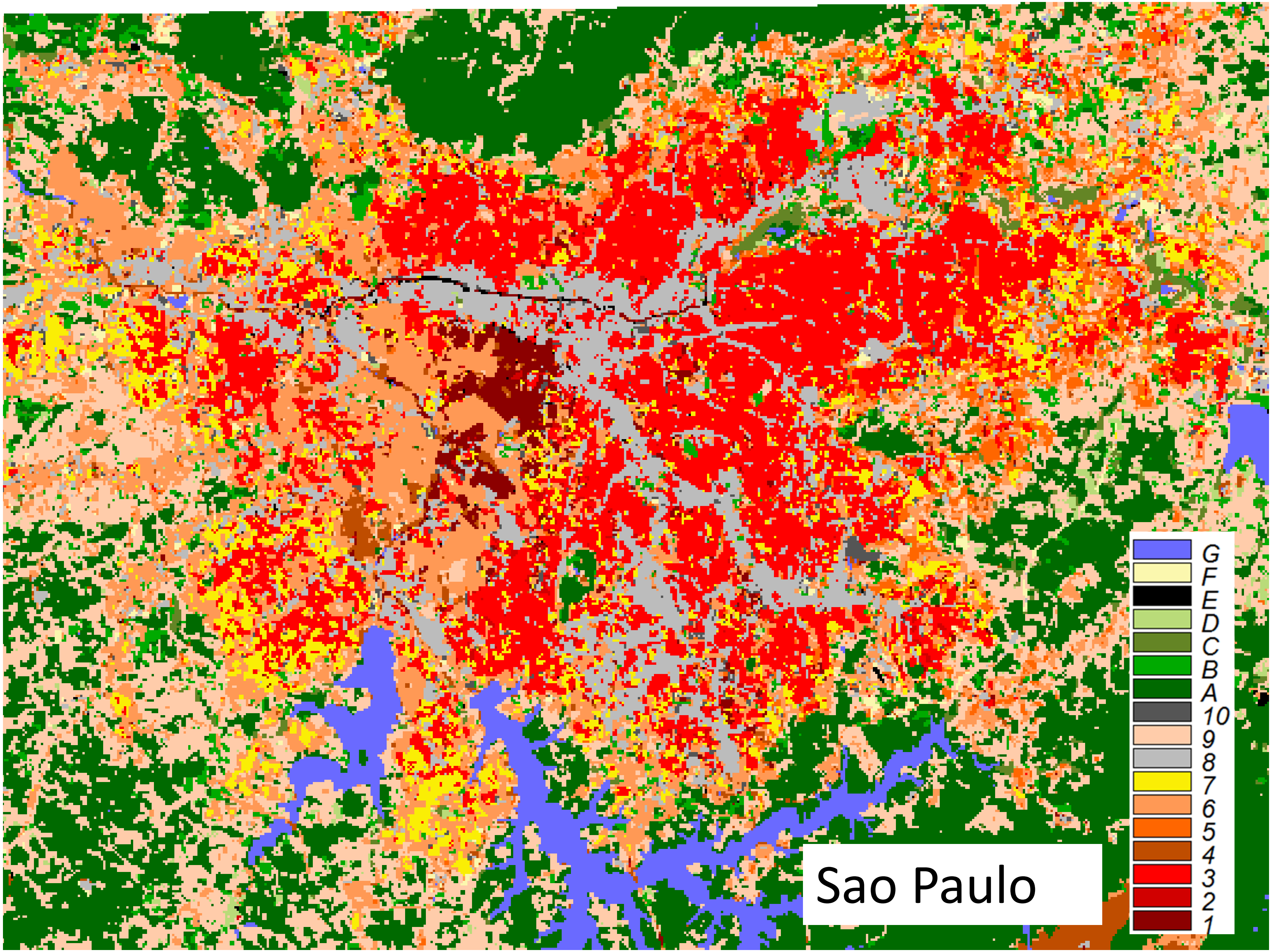


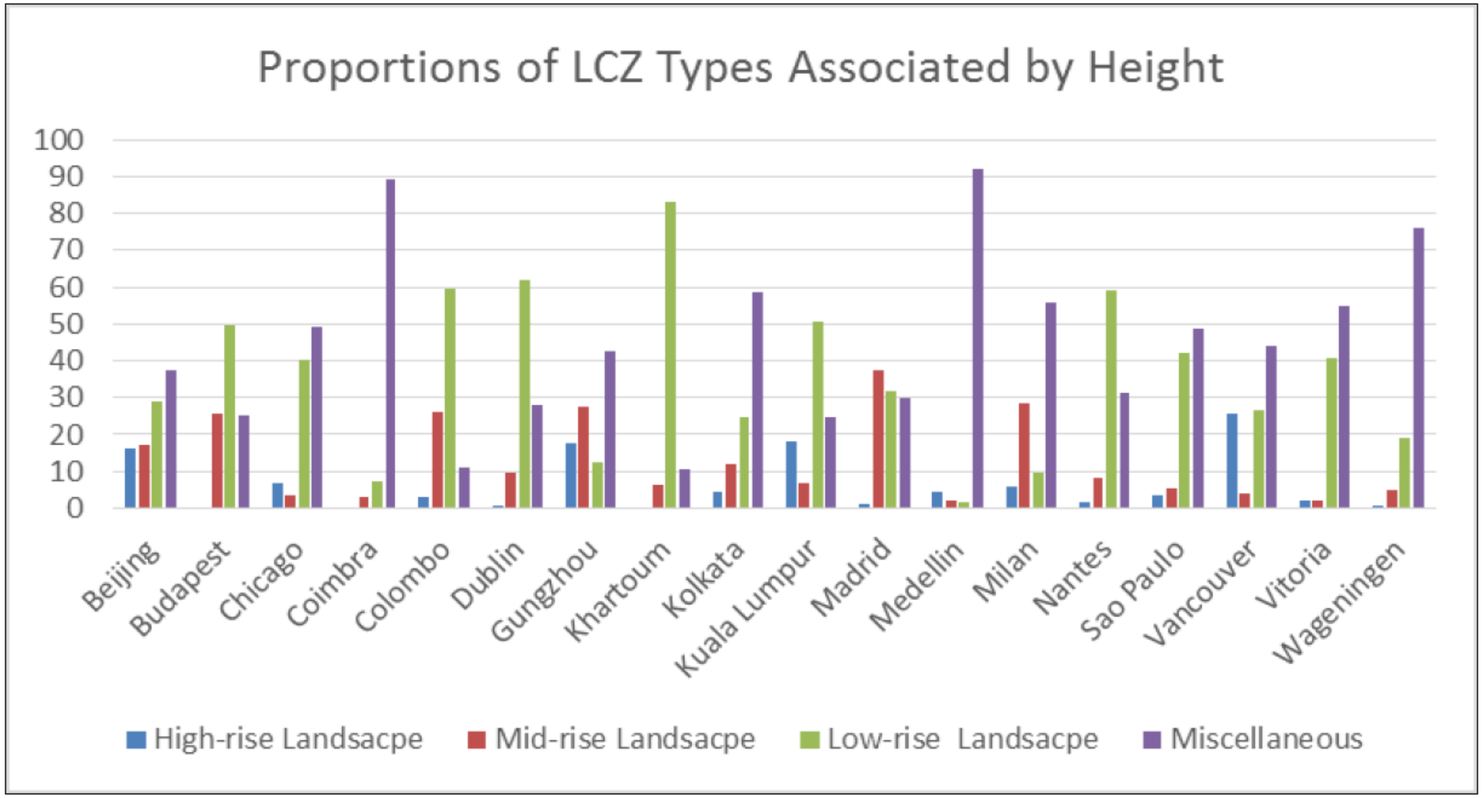
Medelin





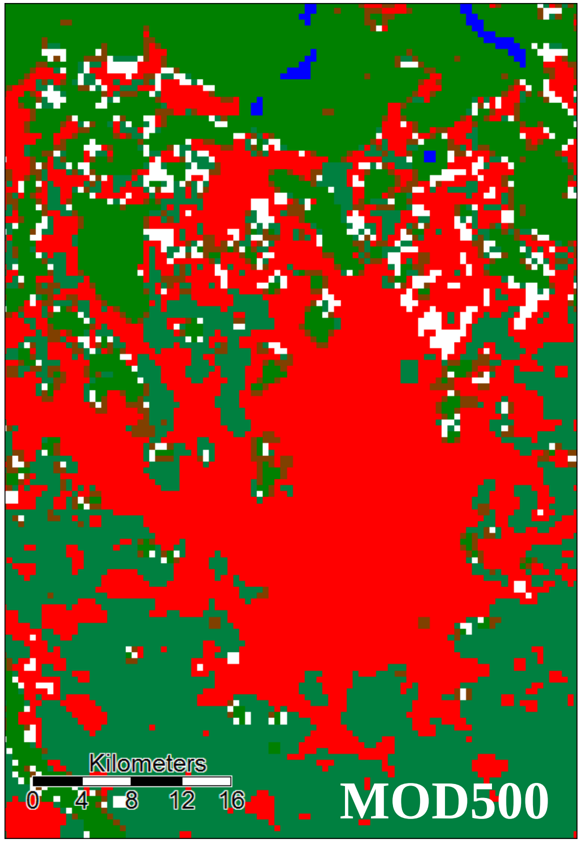
Nantes

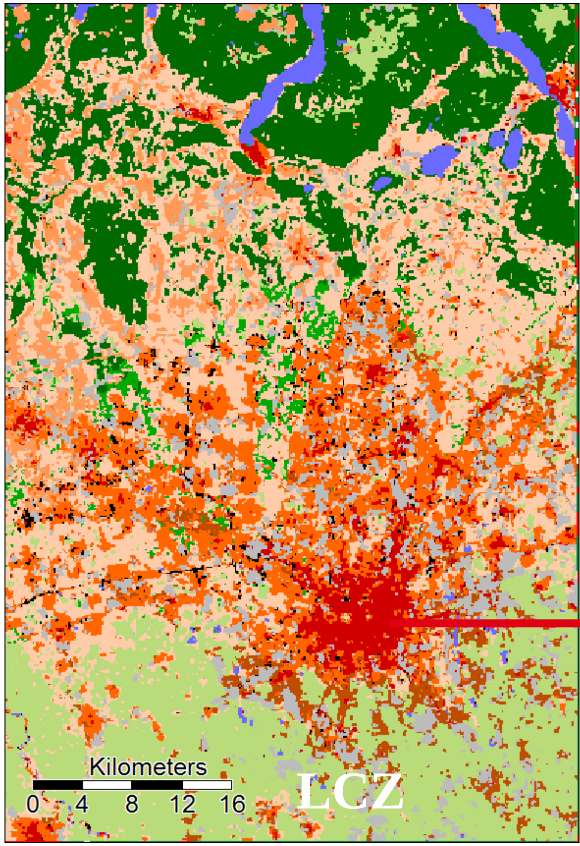

Sao Paulo
G
F
E
D
C
B
A
10
9
8
7
6
5
4
3
2
1

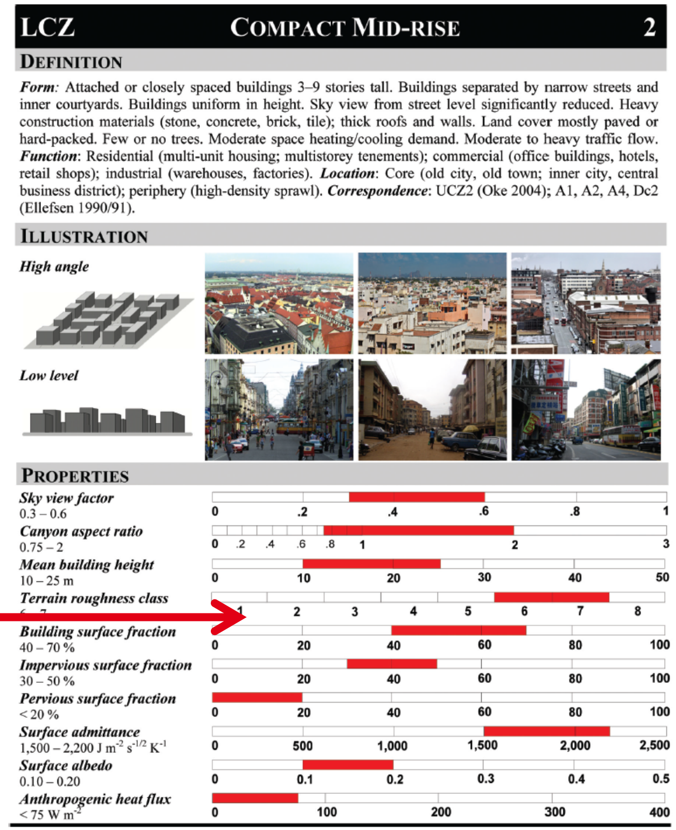

Proportions of LCZ Types Associated by Height
100
90
80
70
60
50
40
30
20
10
0
Beijing
Budapest
Chicago
Coimbra
Colombo
Dublin
Gungzhou
Khartoum
Kolkata
Kuala Lumpur
Madrid
Medellin
Milan
Nantes
Sao Paulo
Vancouver
Vitoria
Wageningen
High-rise Landsacpe
Mid-rise Landsacpe
Low-rise Landsacpe
Miscellaneous

Foley 2015

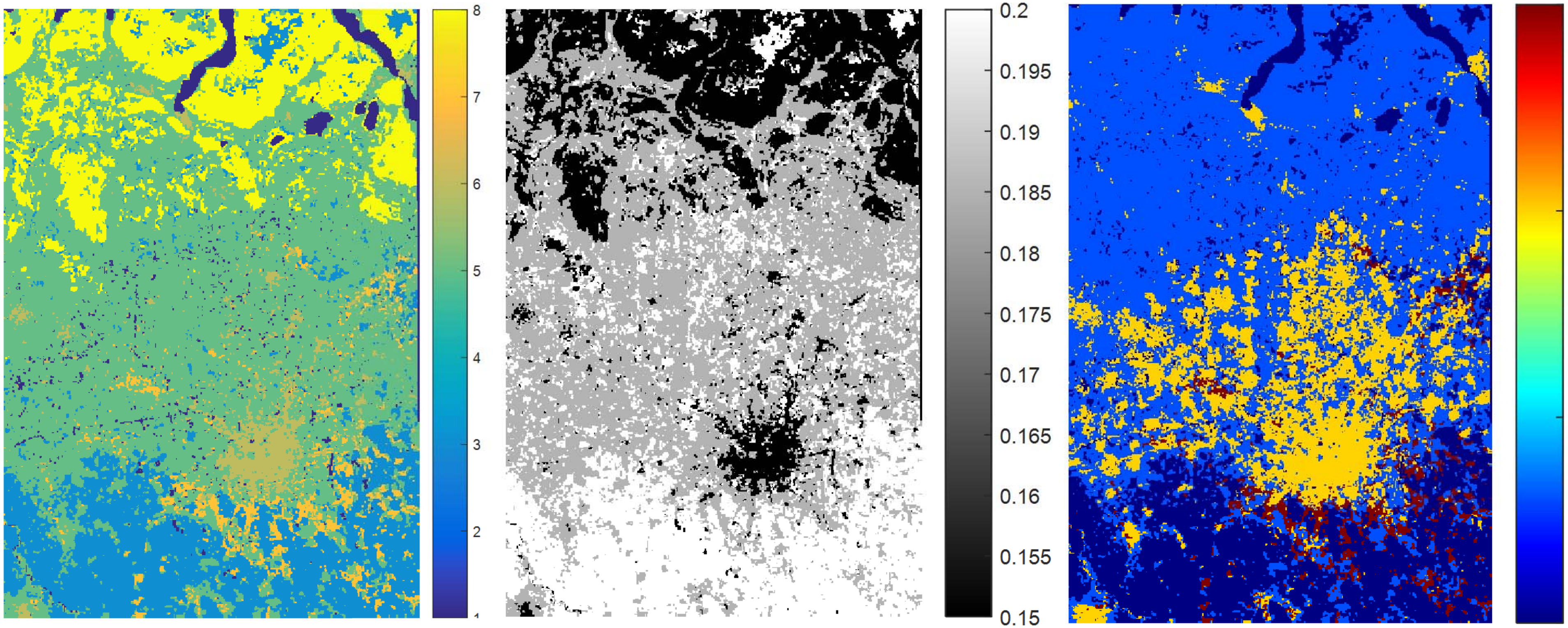
Achievements of level 0







Stewart & Oke 2012



DRC min **α mean** **Height min**

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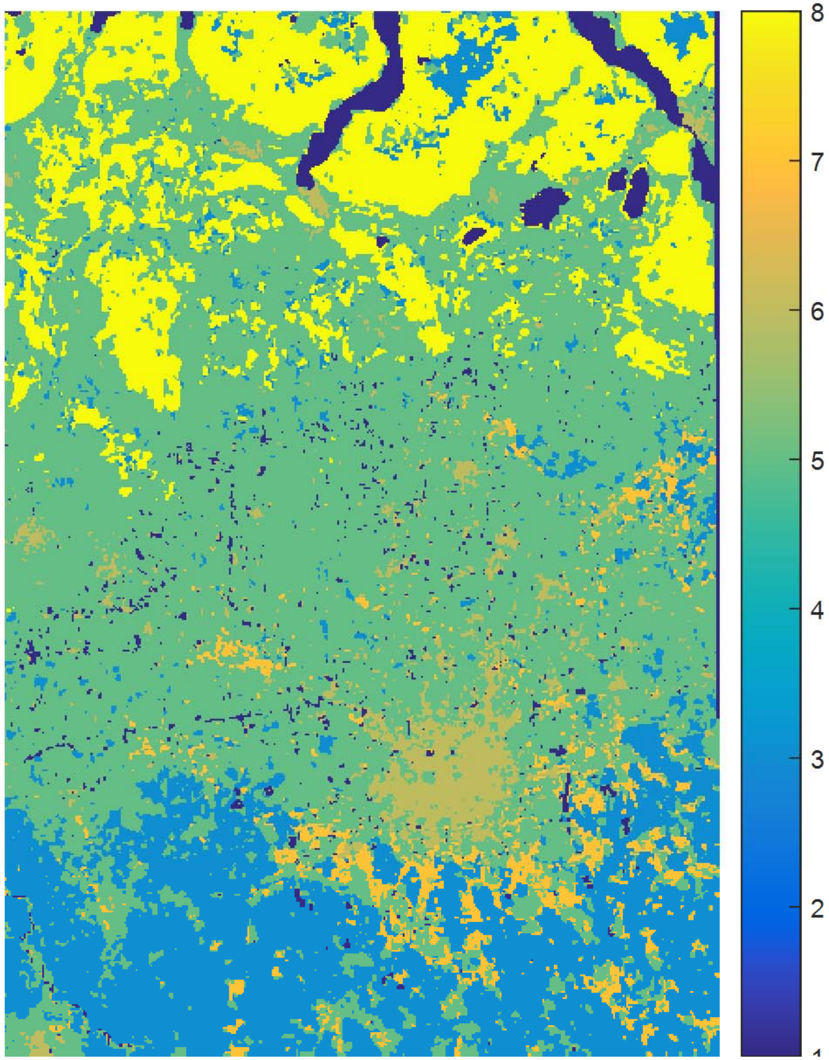
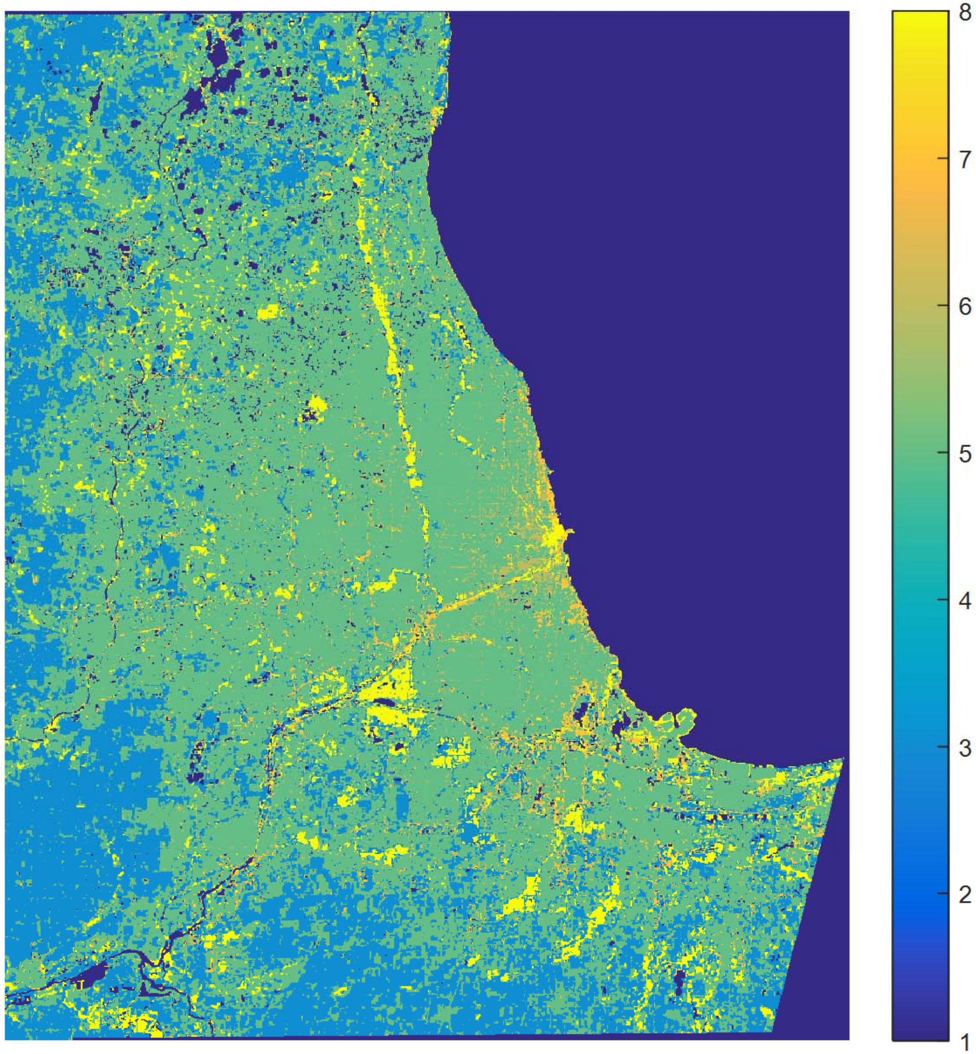
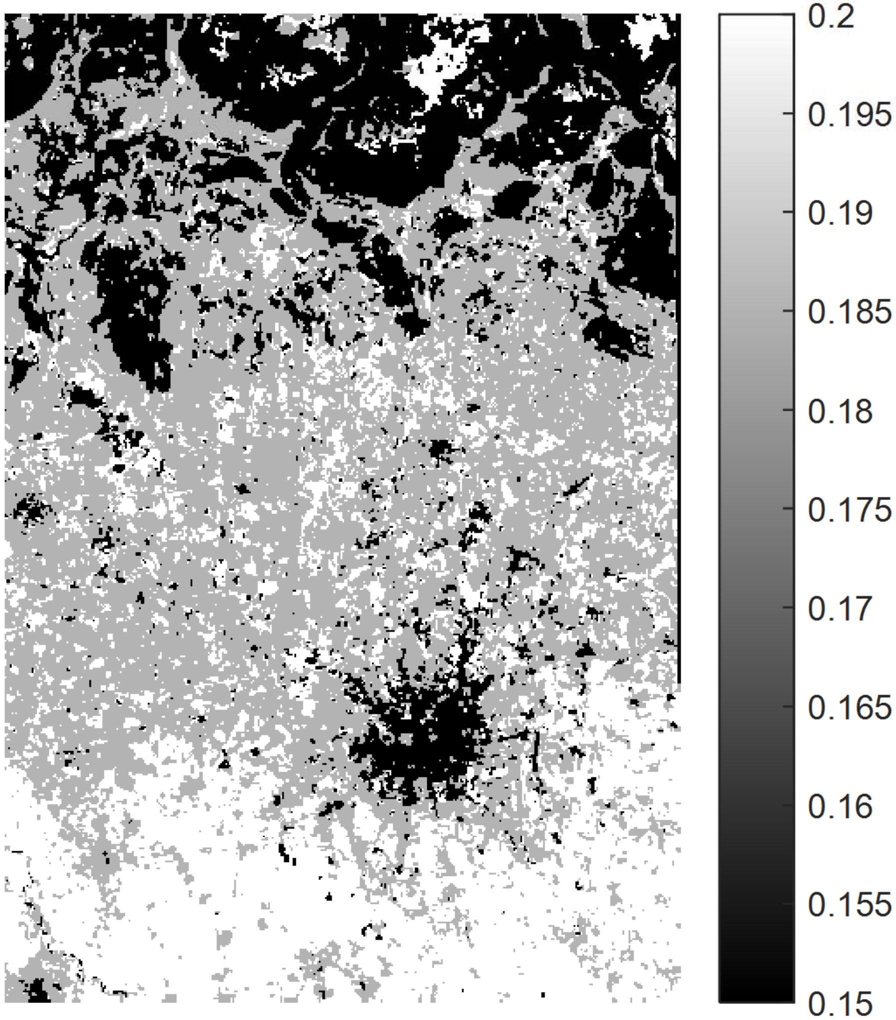
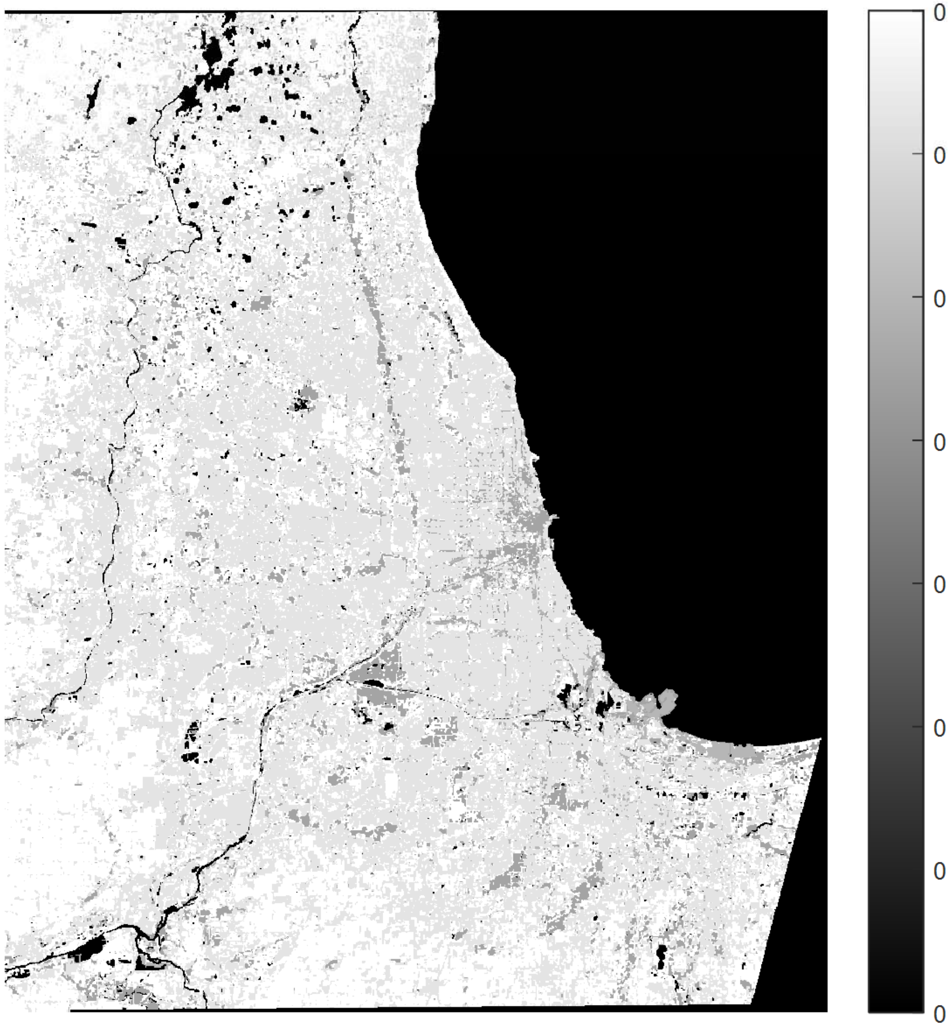
DRC_min

cen






0.2
0.195
0.19
0.185
0.18
0.175
0.17
0.165
0.16
0.155
0.15


0
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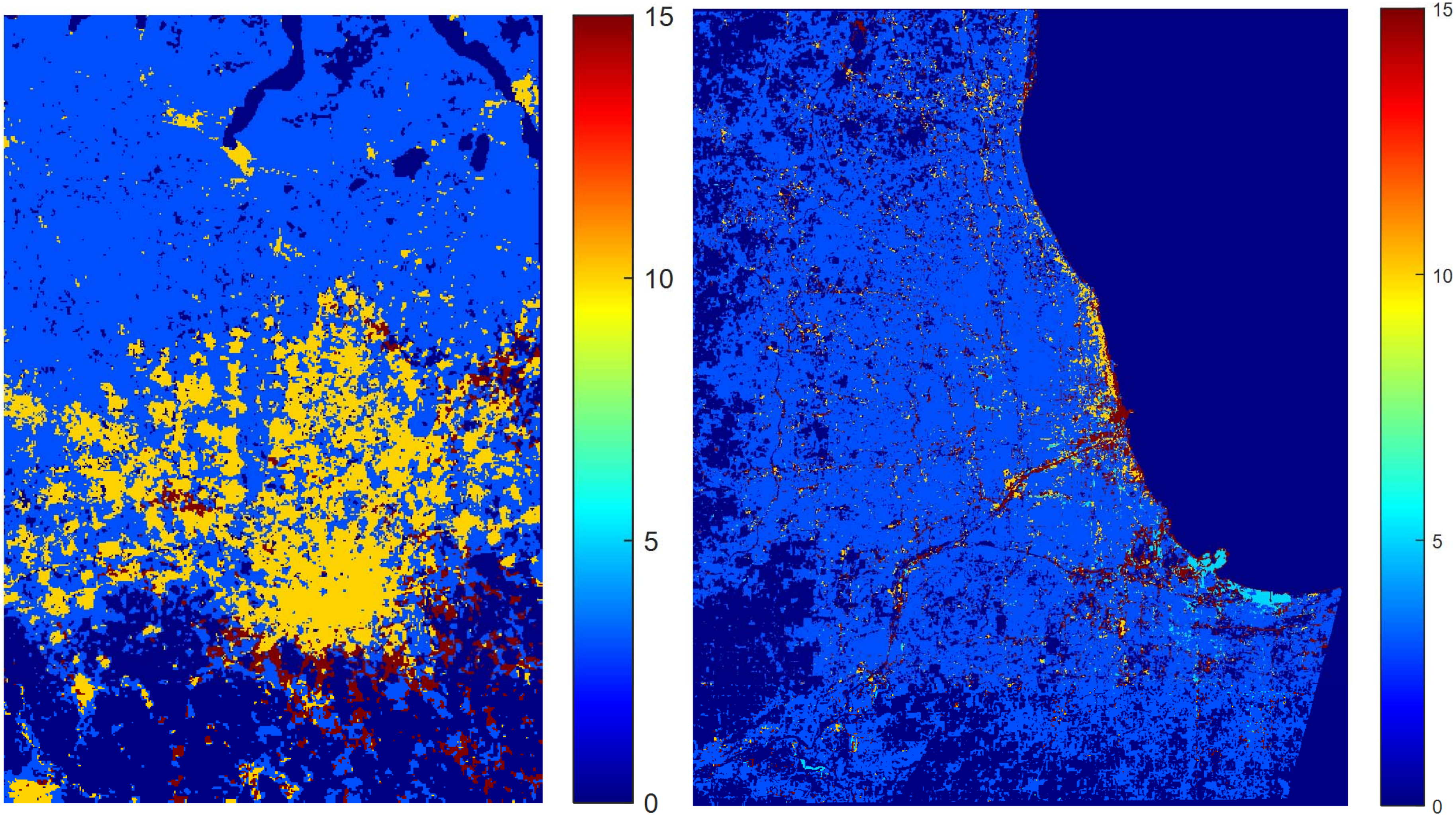
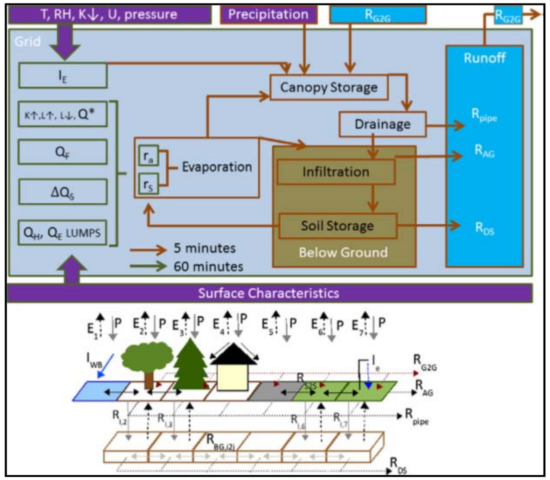
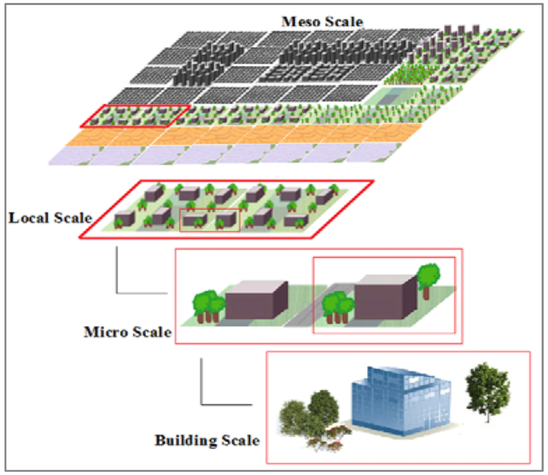
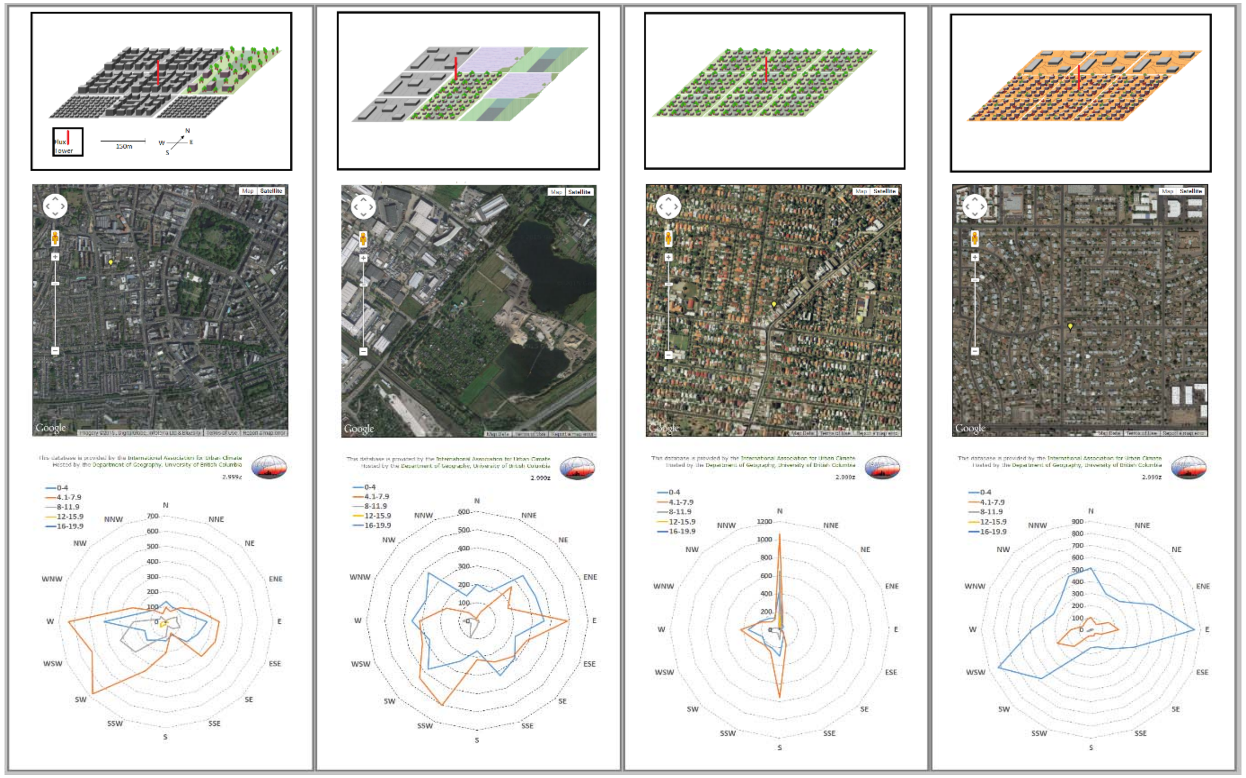
Height (minimum)



Modelling application 1: SUEWS



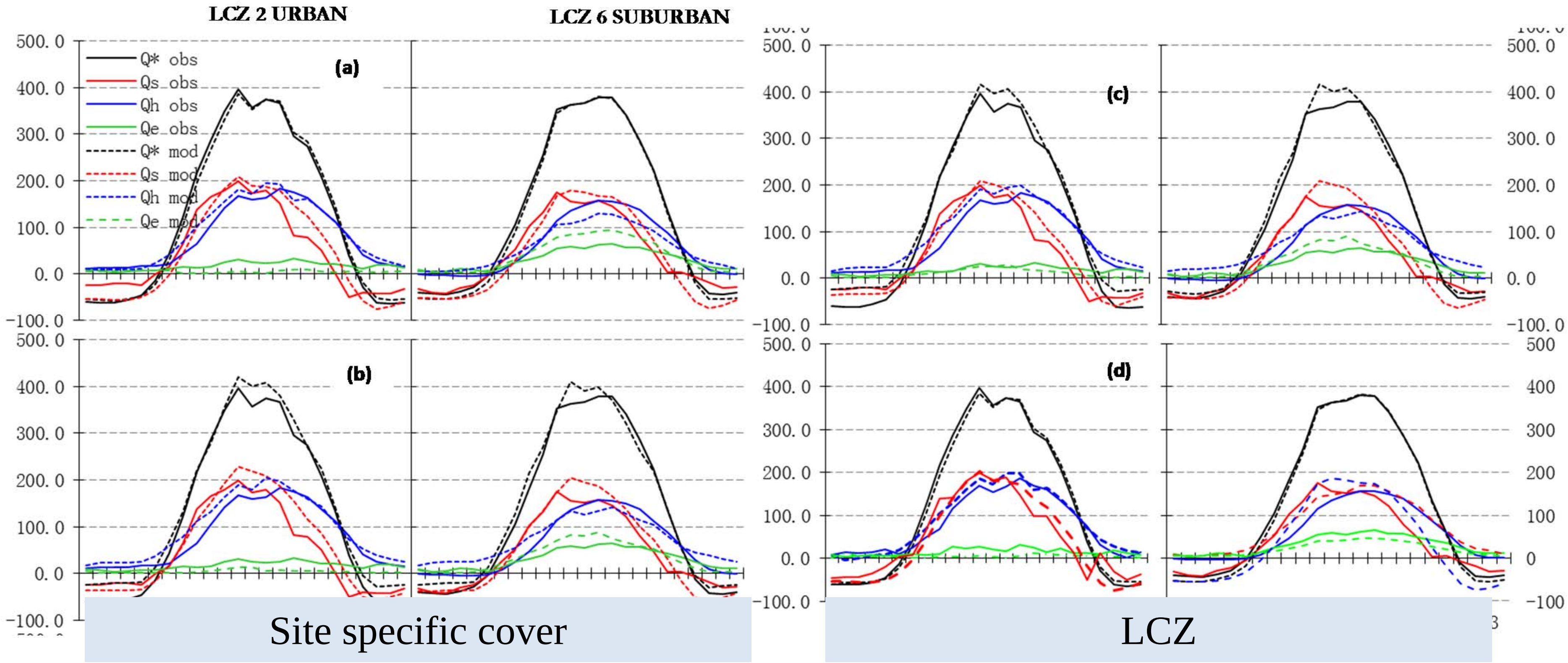




Järvi et al. 2011, Alexander et al. 2016

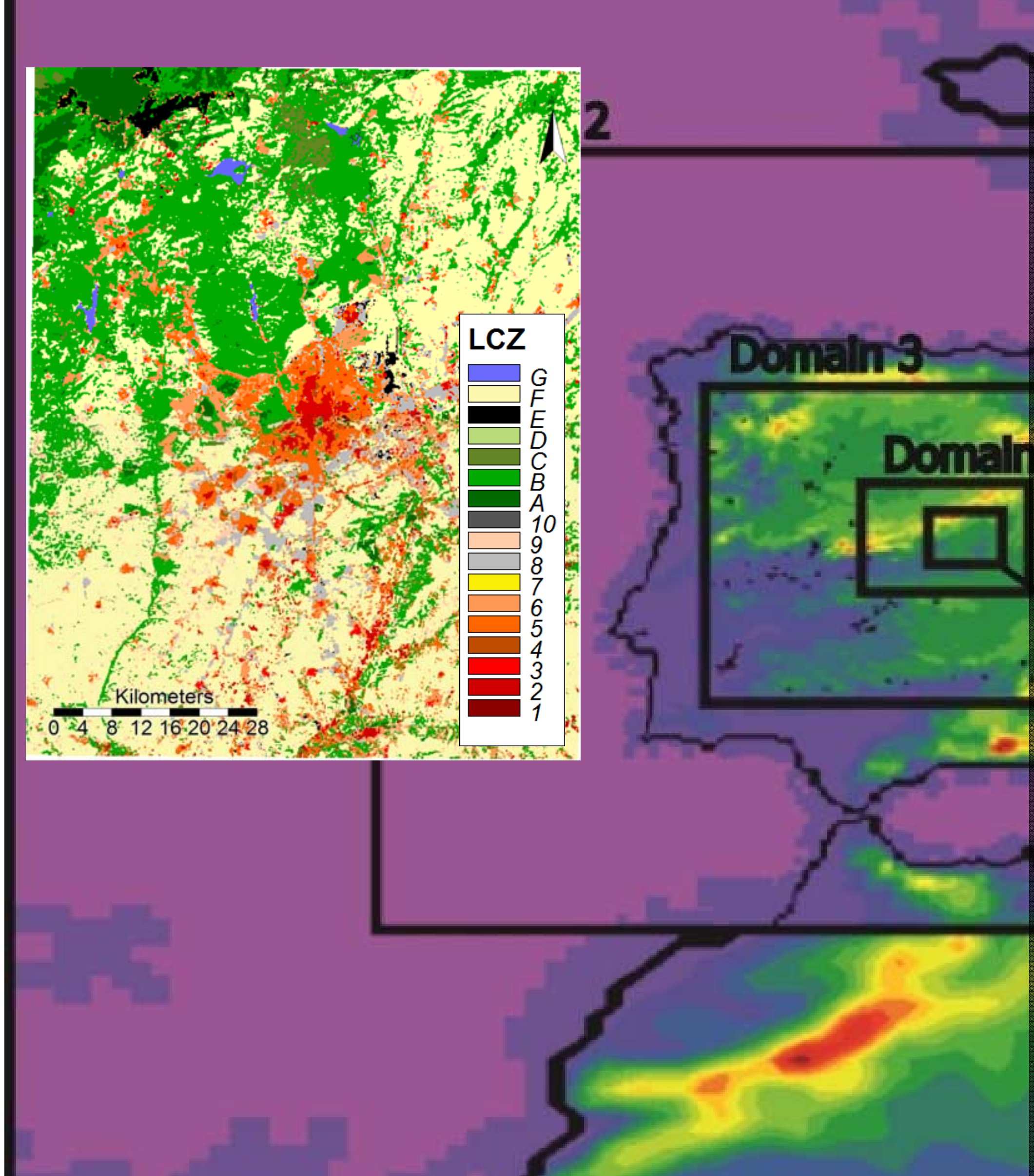
Alexander et al. 2016, urban climate. In review

Running SUEWS with LCZ data



Average hourly energy fluxes (measured and simulated) for June 2010. The graphs on the left refer to the urban site and those on the right refer to the suburban site. The rows (a-d) show simulations when SUEWS is run in different modes (a: Flux Forcing (FF) with Site Specific (SS) land cover, b: Synoptic Forcing (SF) with SS land cover, c: SF with LCZ land cover d: FF with LCZ land cover).

Modelling application 2: WRF



- LCZ slightly better represents the impact of the city on the atmosphere than CORINE data
- local climate is strongly influenced but not fully determined by the morphological and thermal properties of the neighborhoo
- it also depends on the relative location of the neighborhood respect to the rest of the city and the interaction with the meteorological circulations.
- WUDAPT 2 WRF manual now available

Brousse et al. 2016, accepted in Urban Climate

Volunteered Geographic Information (VGI)

"VGI is, fundamentally imperfect, but also generally of unknown and heterogeneous imperfection" (Foody et al. 2014)

A more recent phenomenon is the widespread engagement of untrained citizens in the creation of geographic information. This "represents a dramatic innovation that will certainly have profound impacts on geographic information systems (GIS) and more generally on the discipline of geography and its relationship to the general public" (Goodchild 2007).

Human influence experiment - participants

City	Contact	N	Experience	time	input on LCZ	Completed
Berlin	DF, MO	9	6 B.Sc., 3 PhD/M.Sc.	2 days (16h)	yes	Dec. 2015
Athens	PS	16	M.Sc.		yes	May 2016
Madrid	OB	+- 25 **	B.Sc (Geography)	16h	yes	Dec. 2015
Amsterdam	GS,NT	20	M.Sc	4 h	yes	March 2016
Leuven	MD	+- 35	B.Sc	9h	yes	June 2016
Ghent	MLV	+- 14	B.Sc	12h	yes	June 2016
Las Vegas & Phoenix	AM	7 + ?	Ph.D + ?	1 day + ?	yes	Nov. 2015 + fall 2016
Cyprus ??						

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15.4.2016 Leuven, BELGIUM - © Matthias Demuzere

Let‘ get started

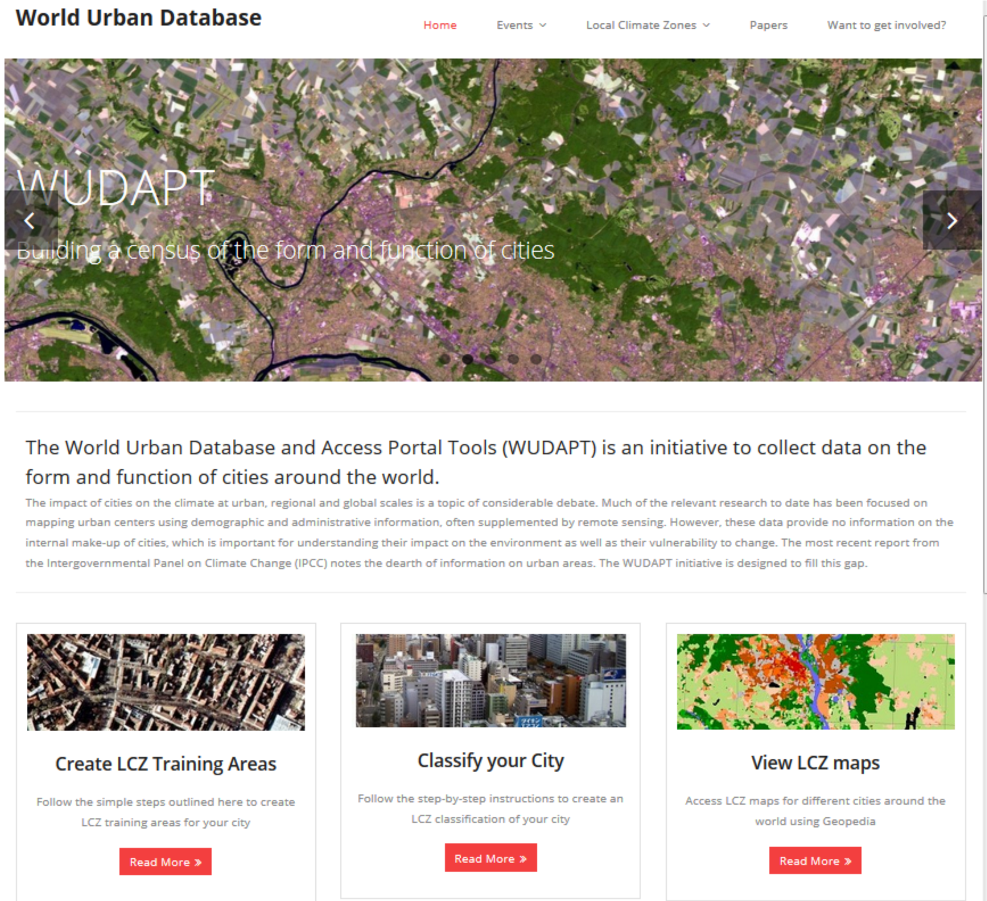
LCZ driving test

bit.ly/LCZdrive

Workshop – training data

- Laptop (Windows)
- Google Earth
- SAGA (on USB drive)
- LCZ factsheets (on USB drive)
- Training area template (KML)
- Internet

- Can work in groups

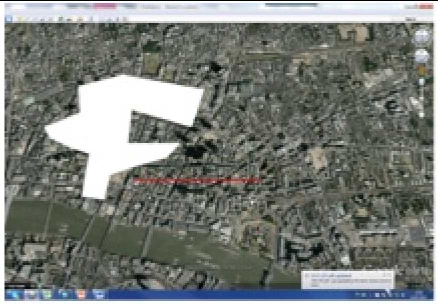
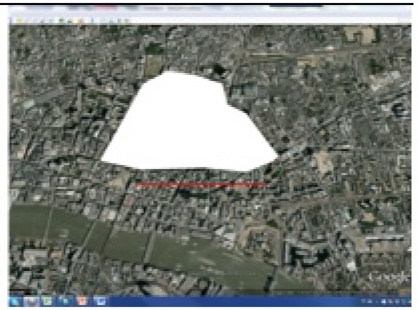
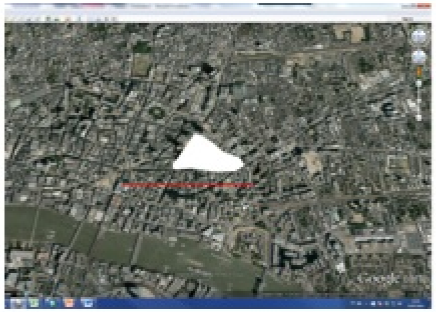
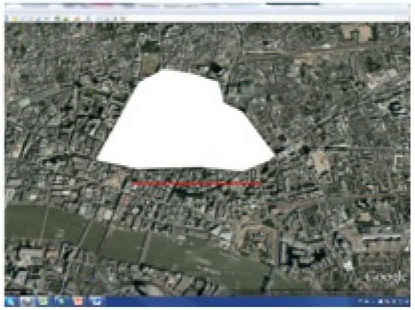
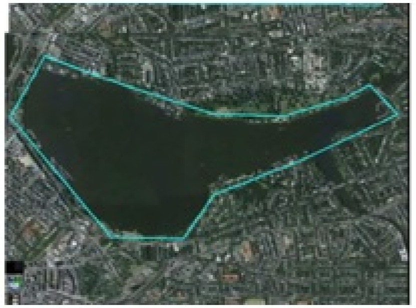


How to Digitize a LCZ Polygon

- Select the LCZ type subfolder that corresponds to the area you are going to digitize. For example, choose LCZ LCZ 1 or 2, i.e. areas with compact buildings.
- Turn on the measurement tab so that you can see the size of the training area.
- Select the **Add –> Polygon** tool and provide a unique label (e.g. LCZ1a where a represents the first polygon of this type).
- Digitize the area by outlining points that demarcate the boundary.
- Repeat the procedure several times per class. If a class has different appearances in your city make sure you cover all. As a rule, the more (and the larger) training areas for each LCZ type, the better for classification, since a larger number of training pixels provides a better representation of the variety of signals associated with a LCZ type.
- Once all training areas for this class have been completed, change the style setting for that LCZ type; right-click on the accompanying LCZ folder and select Properties >Style, Color>Share Style. Open the folder and delete the Style Placeholder.

Guidelines for Digitizing Training Areas

- The LCZ scheme describes neighbourhoods that correspond to an area greater than 1 km^2. Thus, look for large ‘homogenous’ areas where the optimal size and shape of training areas is > 1 km^2 and >200 m wide at the narrowest point . Do not digitize small side areas; think at the local scale.
- The geometric accuracy of the training area boundaries is not critical. Leave a buffer of about 100 m between LCZs, if there is a clear boundary.
- There should be several examples (5-15) of each LCZ to help in the automatic classification; account for variations between a LCZ type in different parts of the city (e.g. different roof colors or building materials)
- natural surface cover (e.g. dense trees) needs as much attention as the urban types; these types are needed to delineate the urban footprint.
- Digitize features that are fairly persistent over time, e.g. avoid construction sites and harvested fields.
- Use Streetview and georeferenced images where available to confirm your categorisation of the neighbourhood.

Properties	✗	✓
Compact shapes Avoid complex shapes and digitize simple block shapes as this will maximise the number of satellite pixels that fall within the shape.		
Scale The LCZ scheme is designed for the neighbourhood scale (>1 km^2). Use the measurement tool to ensure that the area enclosed is large enough to be a training area.		
Borders Avoid digitizing close to the borders of an LCZ type. The satellite pixels are likely to fall on the boundary of the training area and receive a mixed signal as a result, which will affect the classification.		

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Let‘ get started – online manuals and data

World Urban Database

Home | Cities | Local Climate Zones | Outreach | Want to get involved?

The World Urban Database and Access Portal Tools (WUDAPT) is an initiative to collect data on the form and function of cities around the world.

The impact of cities on the climate at urban, regional and global scales is a topic of considerable debate. Much of the relevant research to date has been focused on mapping urban centers using demographic and administrative information, often supplemented by remote sensing. However, these data provide no information on the internal make-up of cities, which is important for understanding their impact on the environment as well as their vulnerability to change. The most recent report from the Intergovernmental Panel on Climate Change (IPCC) notes the dearth of information on urban areas. The WUDAPT initiative is designed to fill this gap.

VIEW THE VIDEO

Create LCZ Training Areas

Follow the simple steps outlined here to create LCZ training areas for your city

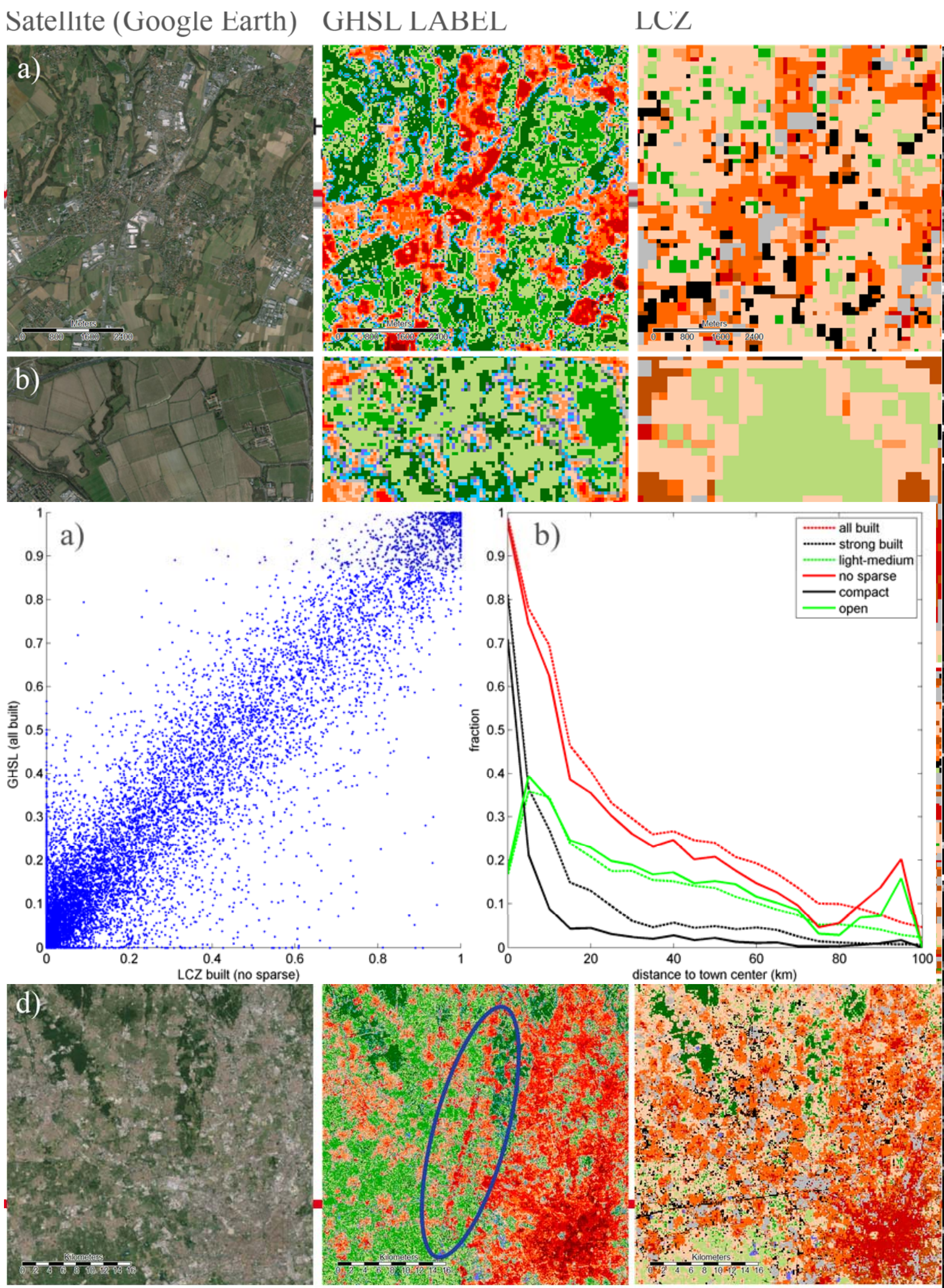
Classify your City

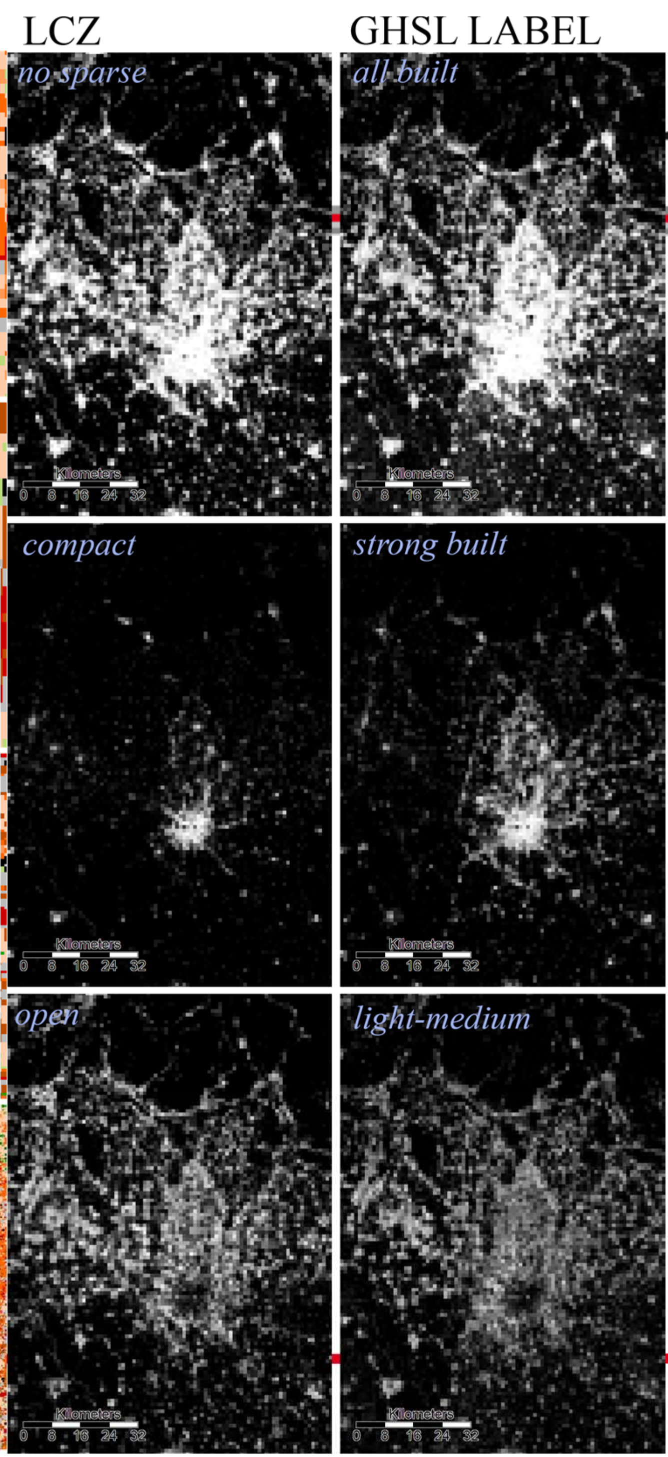
Follow the step-by-step instructions to create an LCZ classification of your city

View LCZ maps

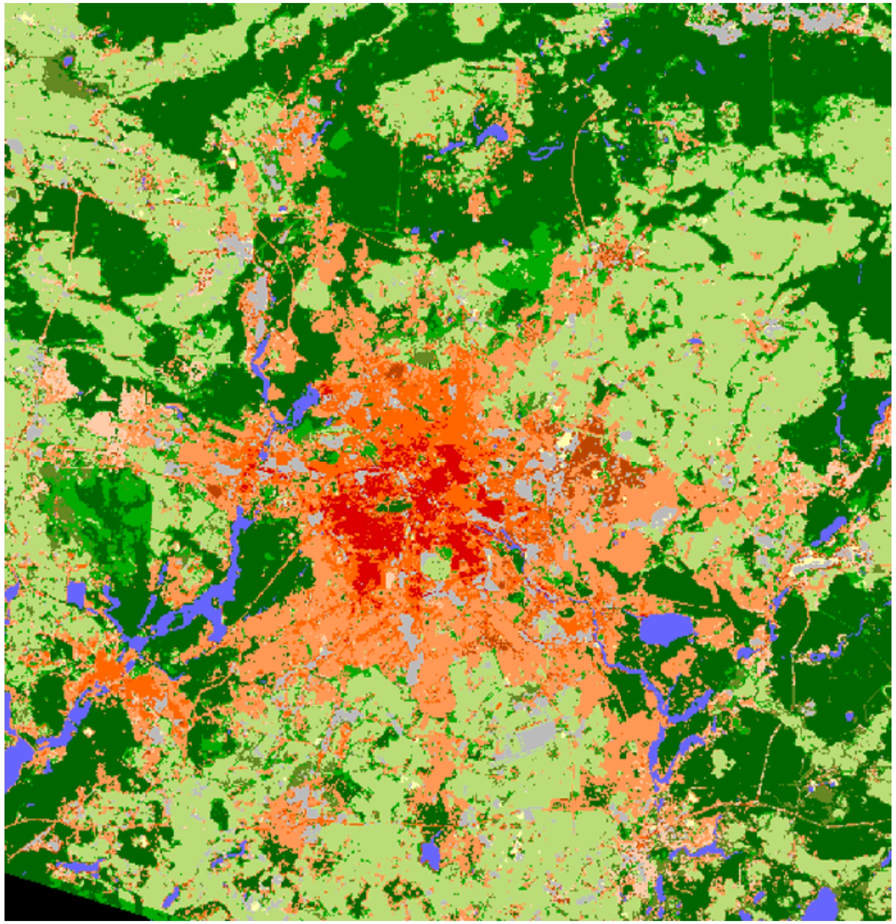
Access LCZ maps for different cities around the world using Geopedia

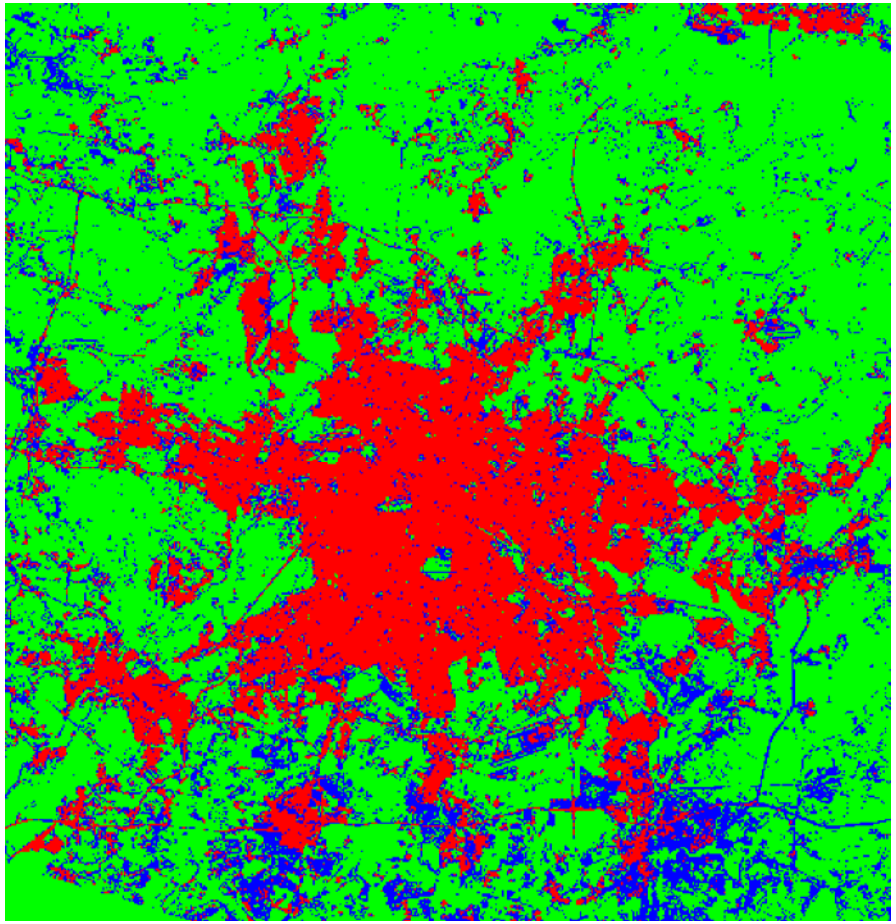
#city_template.zip
Addis_Ababa.zip
Amman.zip
Athens.zip
Bangkok.zip
Berlin.zip
Buenos_Aires.zip
Cairo.zip
Caracas.zip
Dhaka.zip
Dublin.zip
Hanoi.zip
Ho_Chi_Minh.zip
Houston.zip
Istanbul.zip

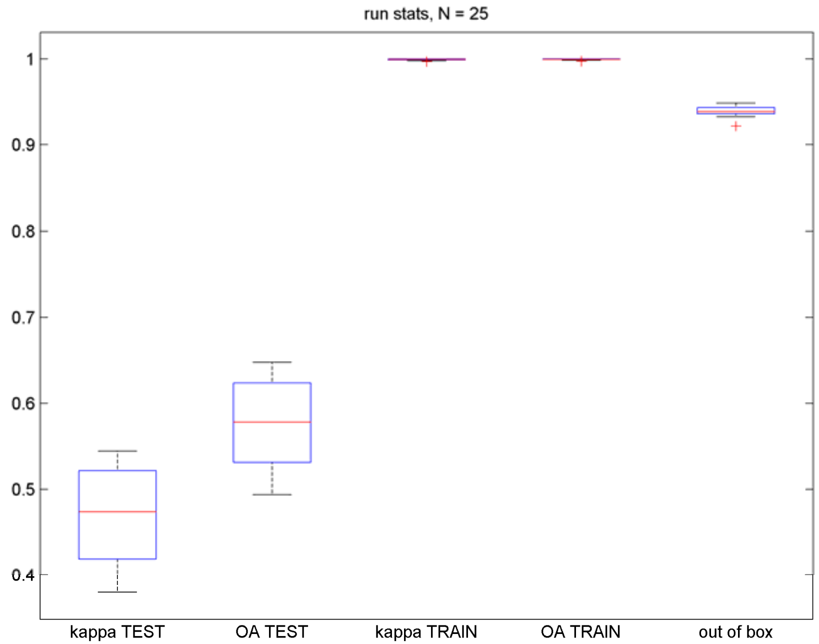


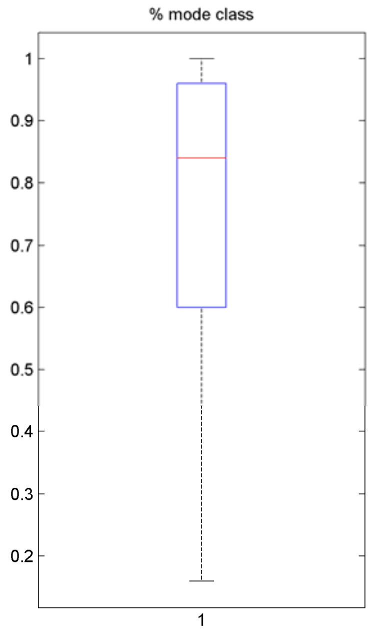


Bechtel et al. 2016. in press






run stats, N = 25
1
0.9
0.8
0.7
0.6
0.5
0.4
kappa TEST
OA TEST
kappa TRAIN
OA TRAIN
out of box


% mode class
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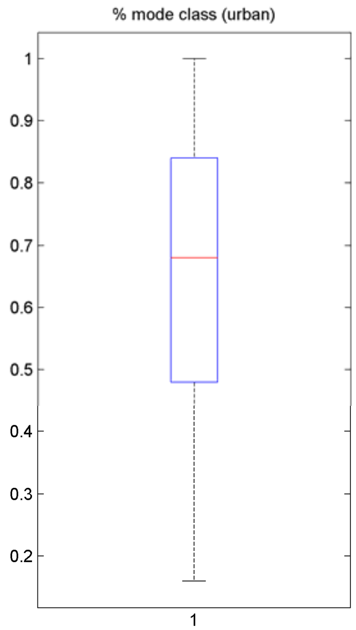
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1


% mode class (urban)
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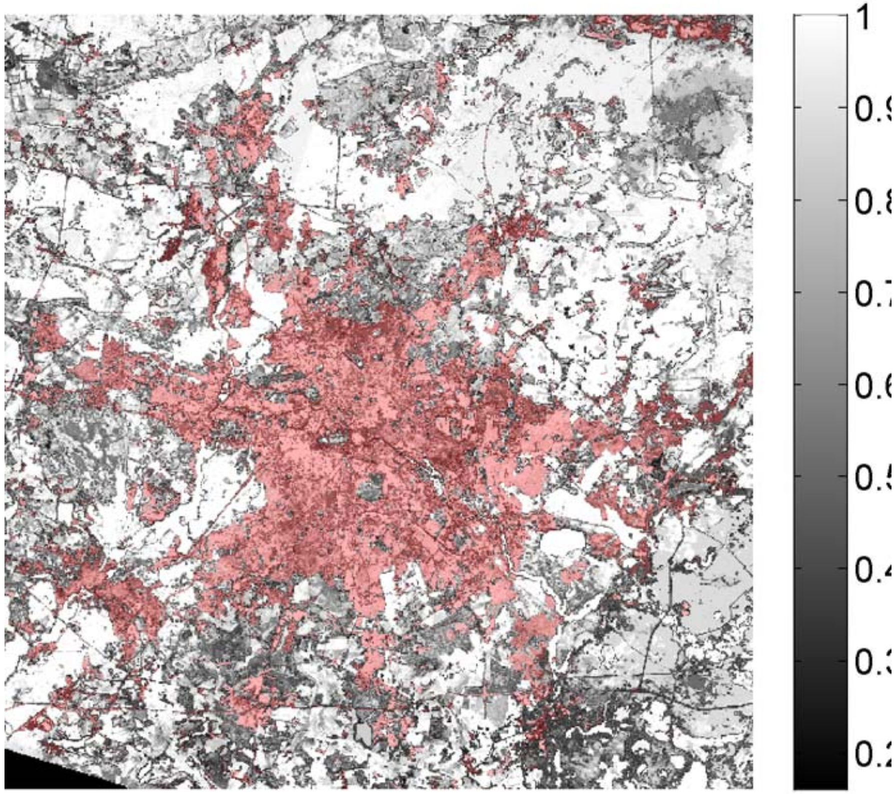
0.8
0.7
0.6
0.5
0.4
0.3
0.2
1


1