CONCILIATING HUMAN DENSITY AND GREEN SPACES IN CITIES

Which urban design could be better for a sustainable future?

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Main questions

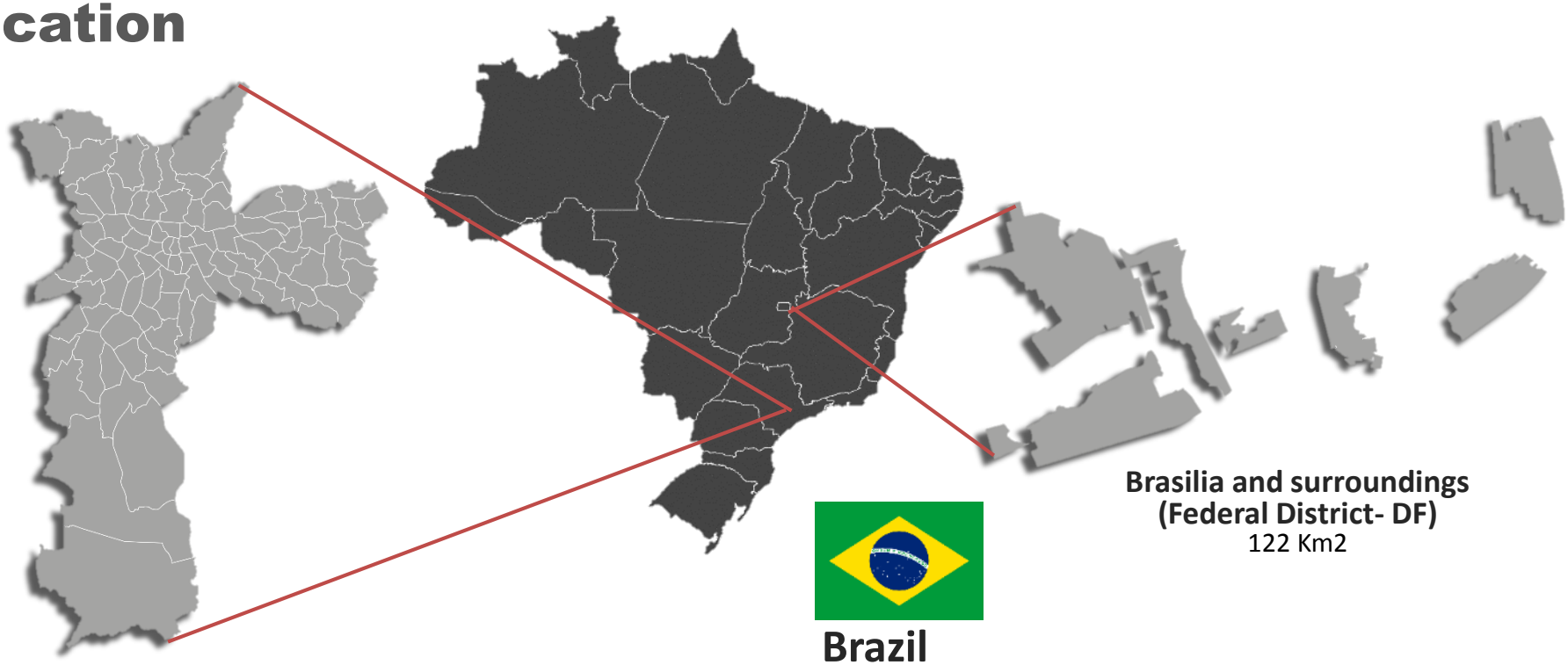
Is it possible to balance high-density and large green spaces?

Can urban design influence positively on this?

How to enhance biodiversity in compact cities?

Which urban form could face those challenges?

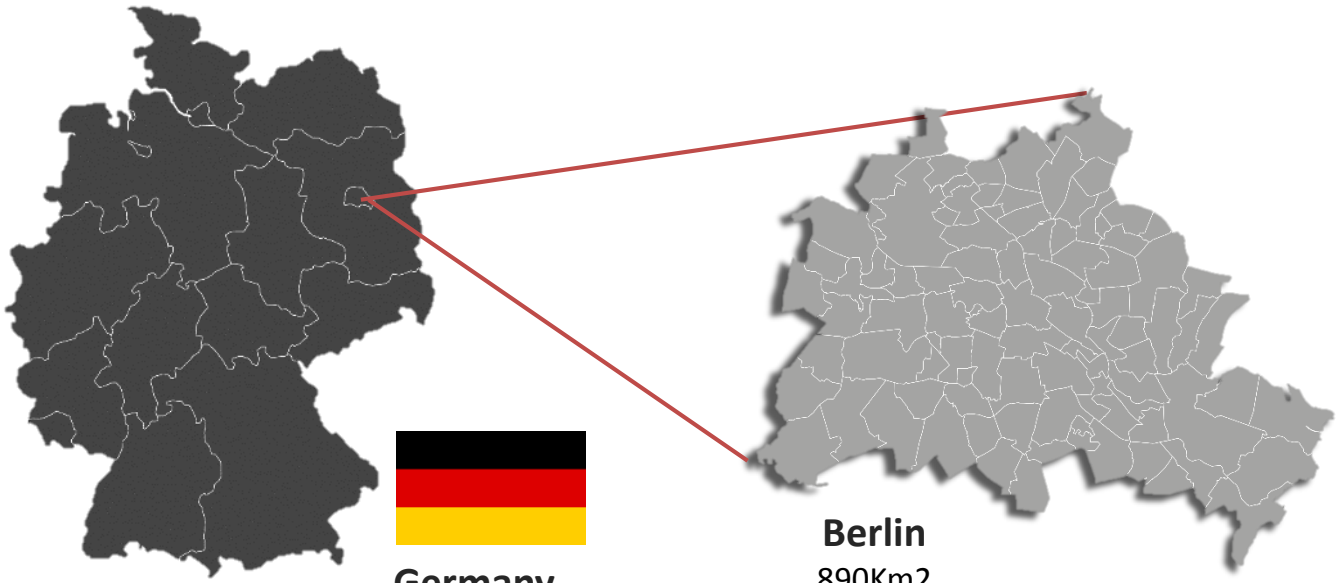
Location



São Paulo City
1.527 km2

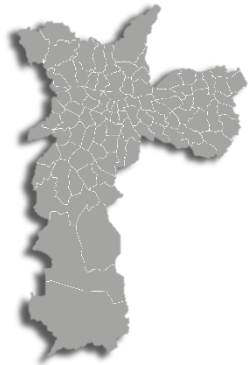
Brasilia and surroundings
(Federal District- DF)
122 Km2

Brazil



Germany

Berlin
890Km2



São Paulo City

Brasilia and surroundings

Berlin

CRITERIA

REQUIREMENTS

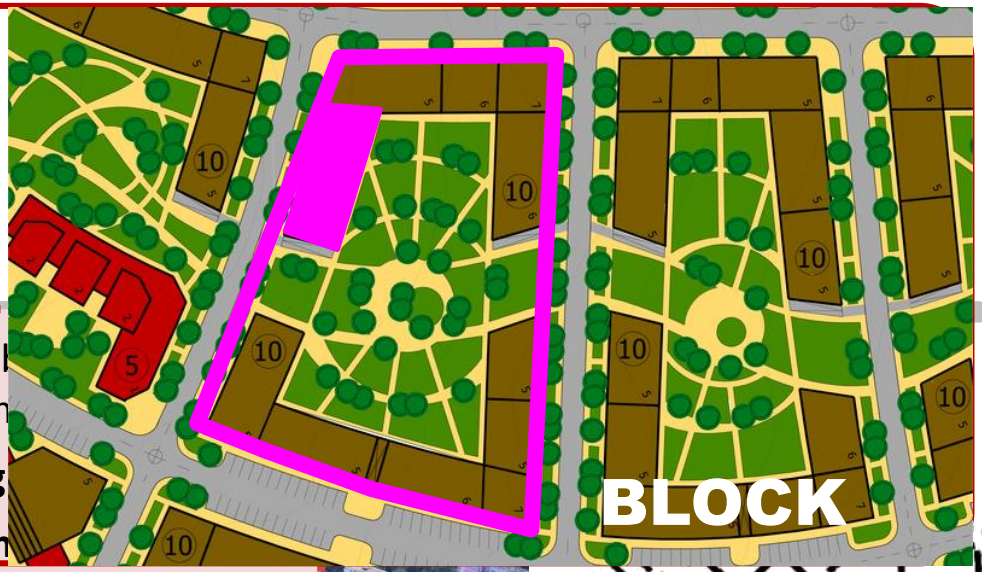
Configuration: I
spaces (includin

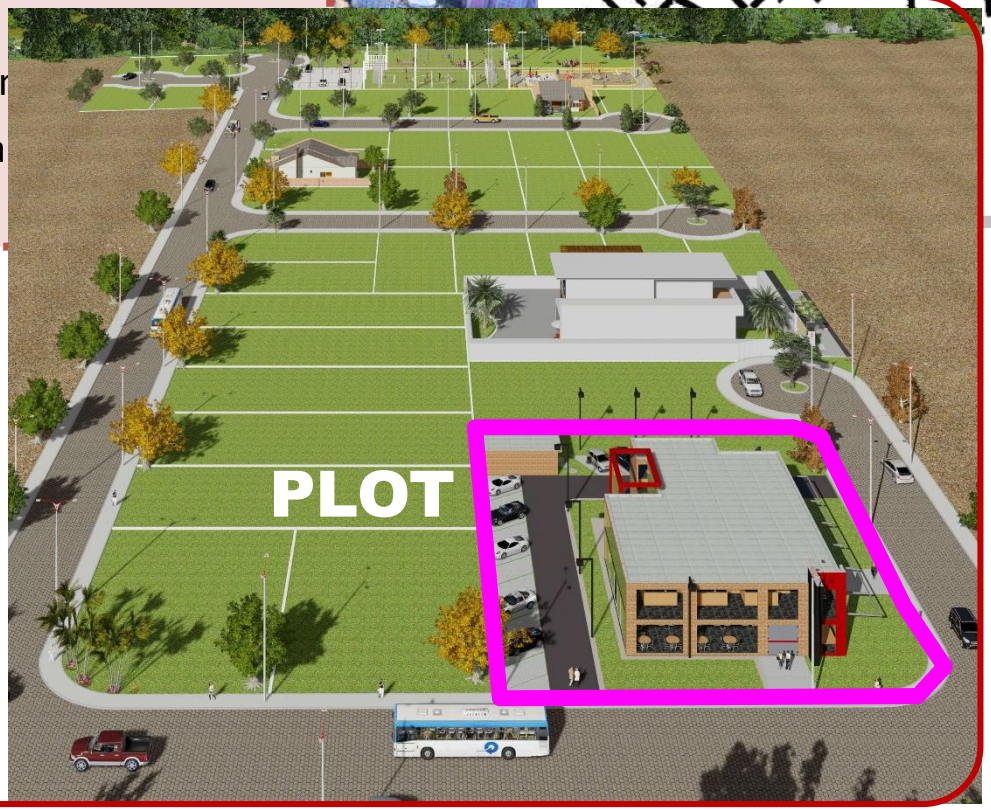
Shape and **heig**

Layout **site plan**
and the block

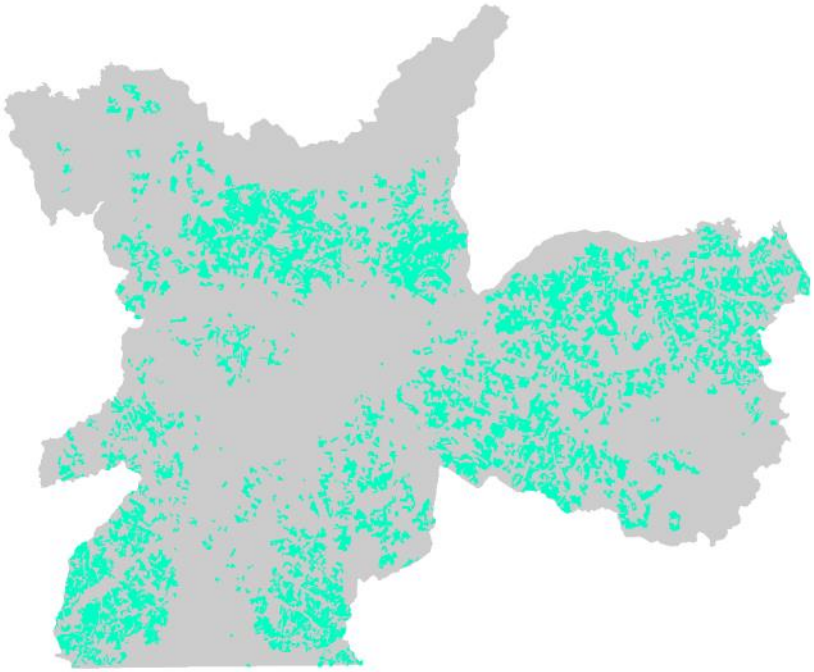
Residencial or r

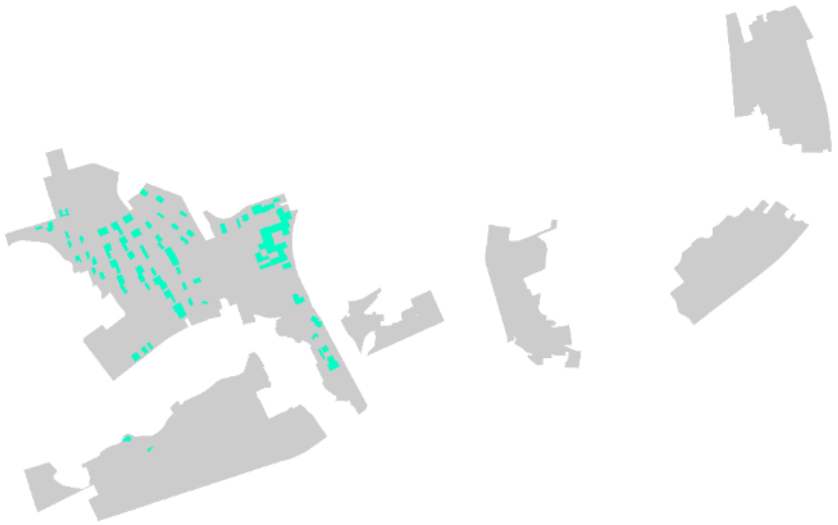
High-density: a
dwellings/ha





Mapping





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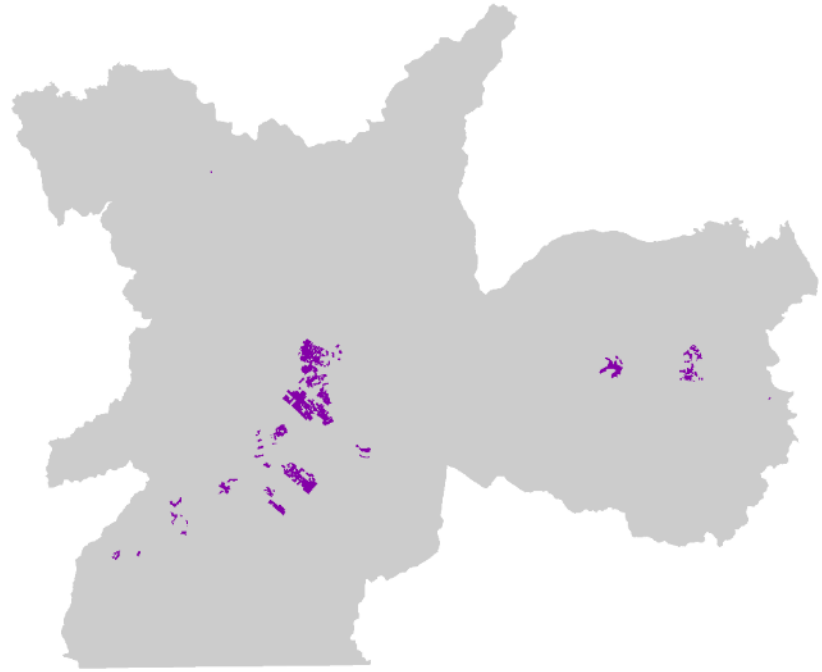
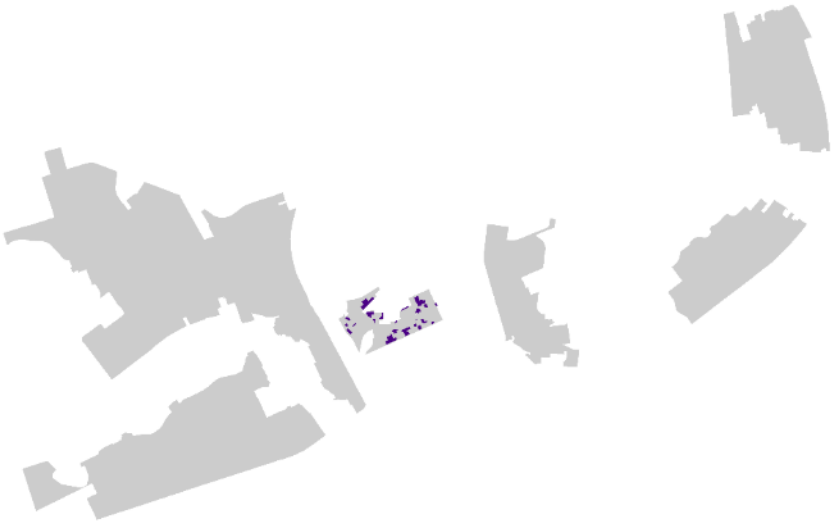
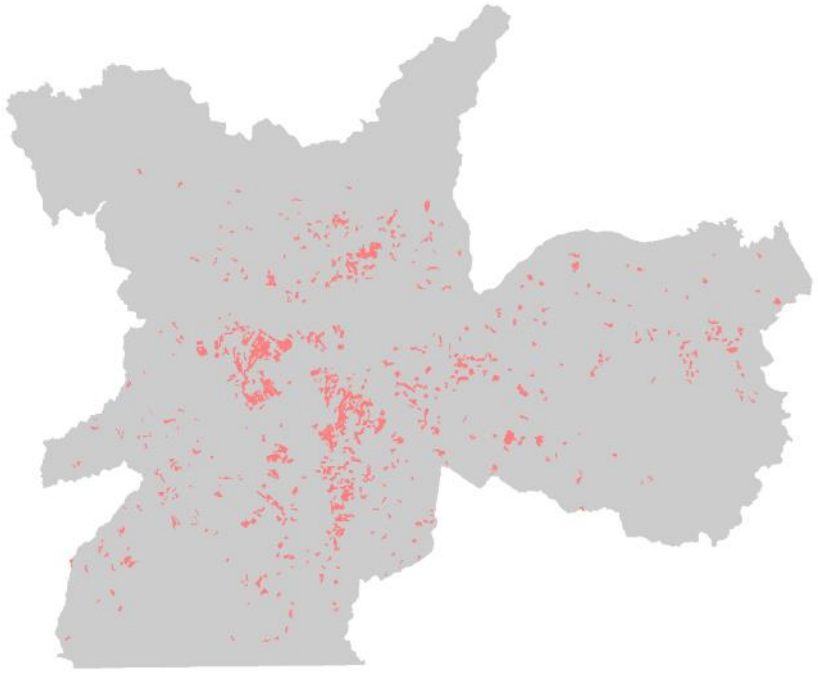
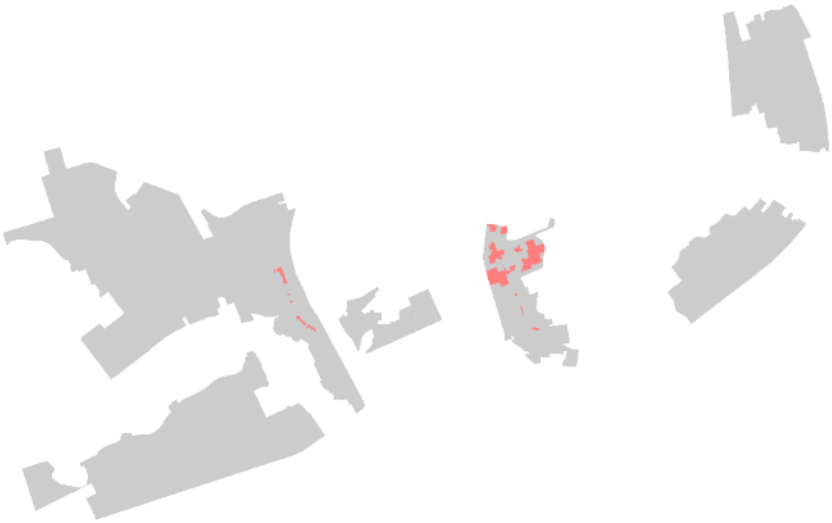


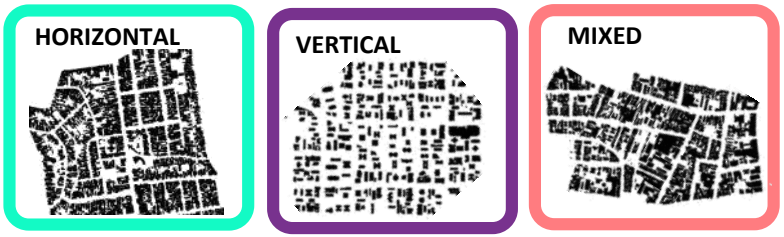


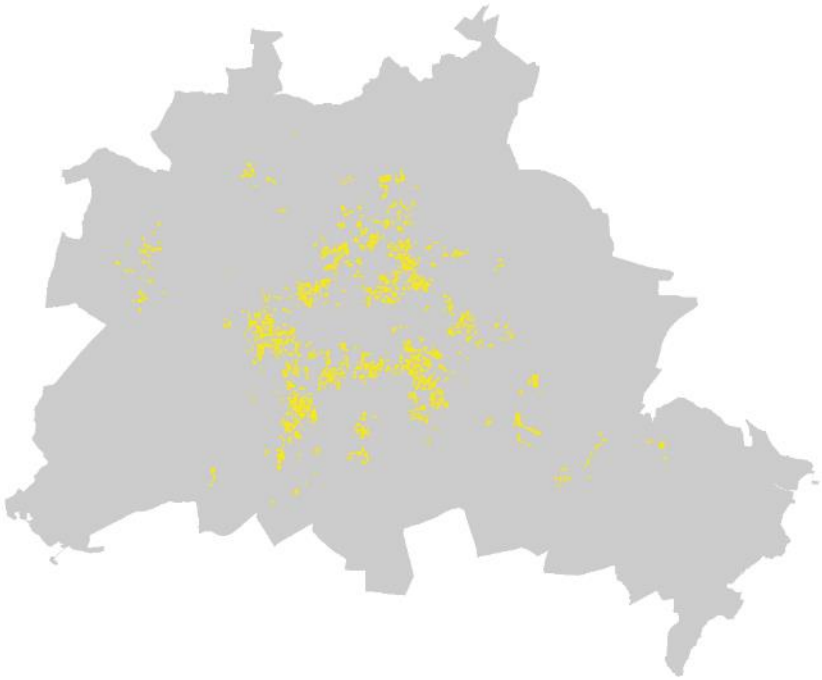
HORIZONTAL

VERTICAL






HORIZONTAL
VERTICAL
MIXED

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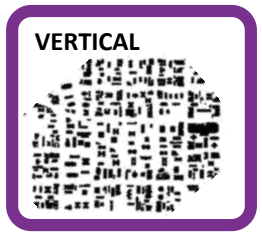
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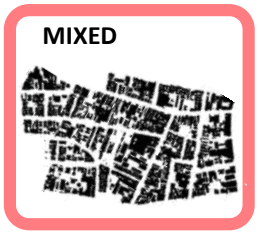
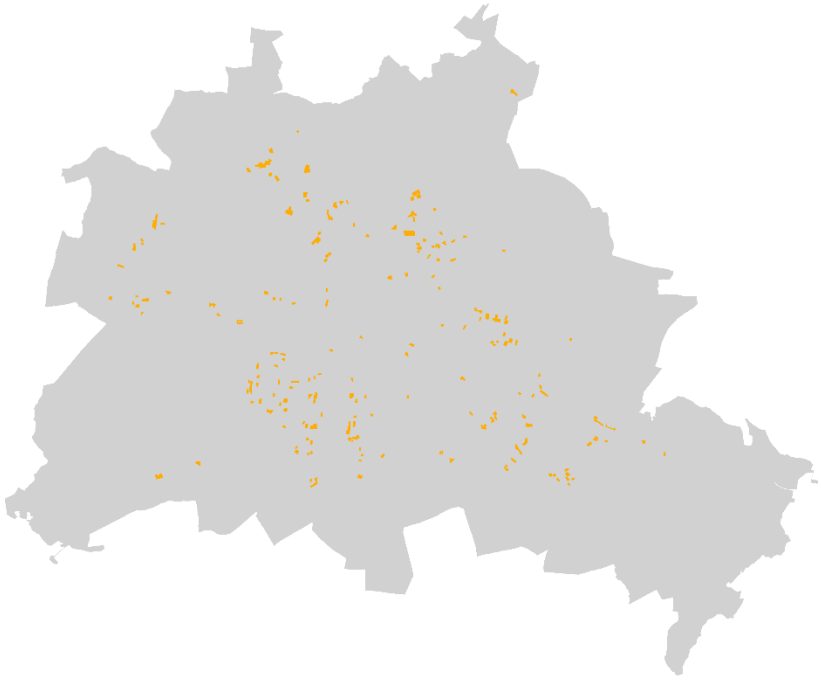

MIXED


TRADITIONAL

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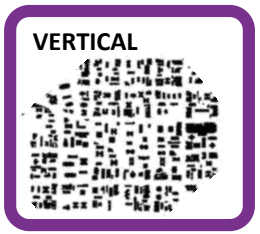
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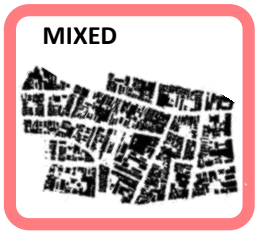
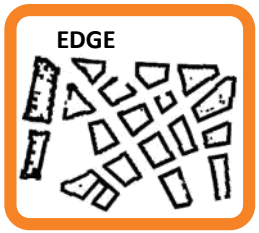
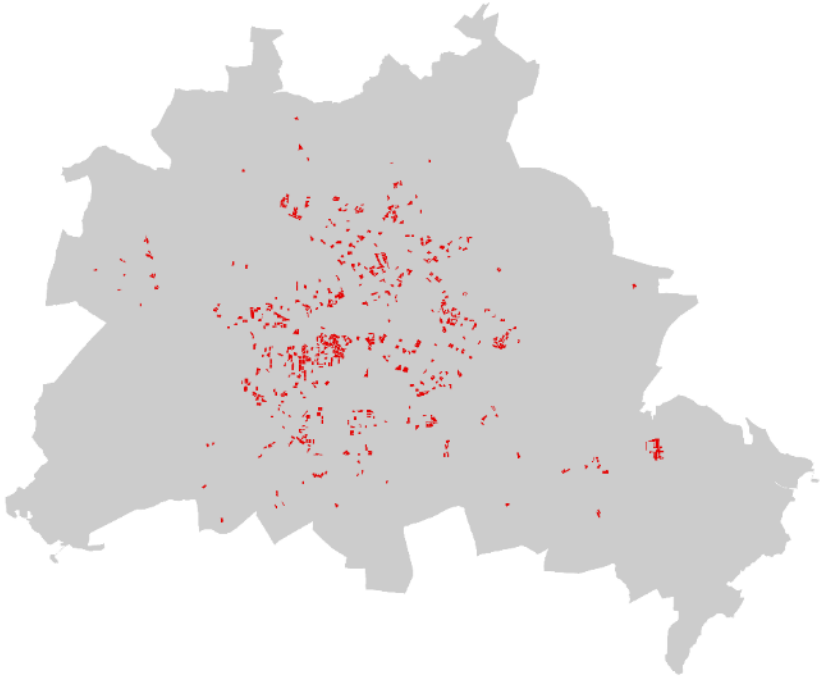
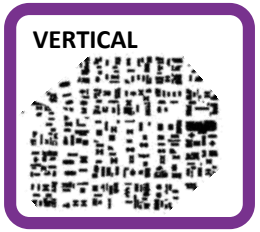

MIXED

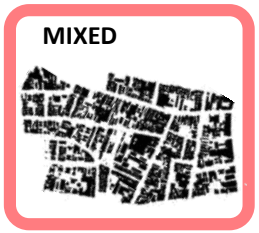

TRADITIONAL


EDGE




HORIZONTAL


VERTICAL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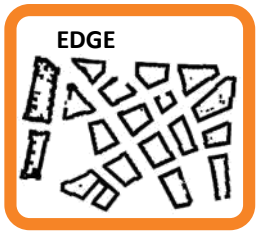
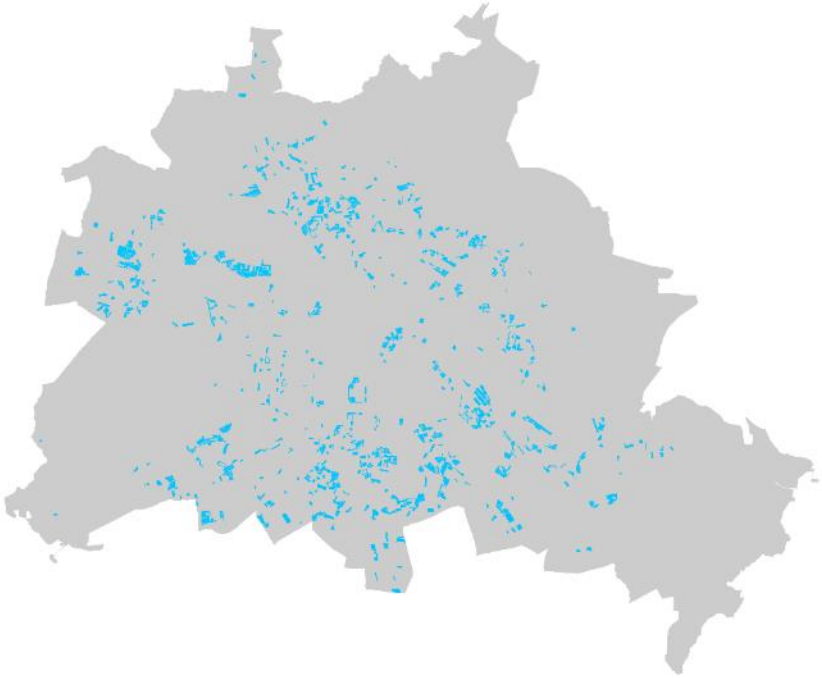

EDGE


HALF-OPEN

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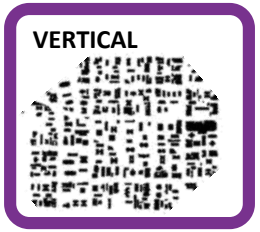
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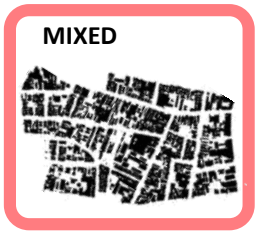
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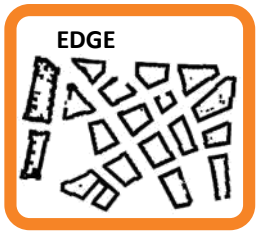
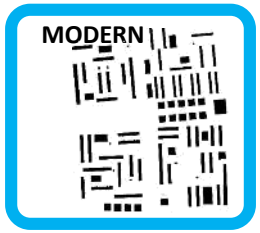
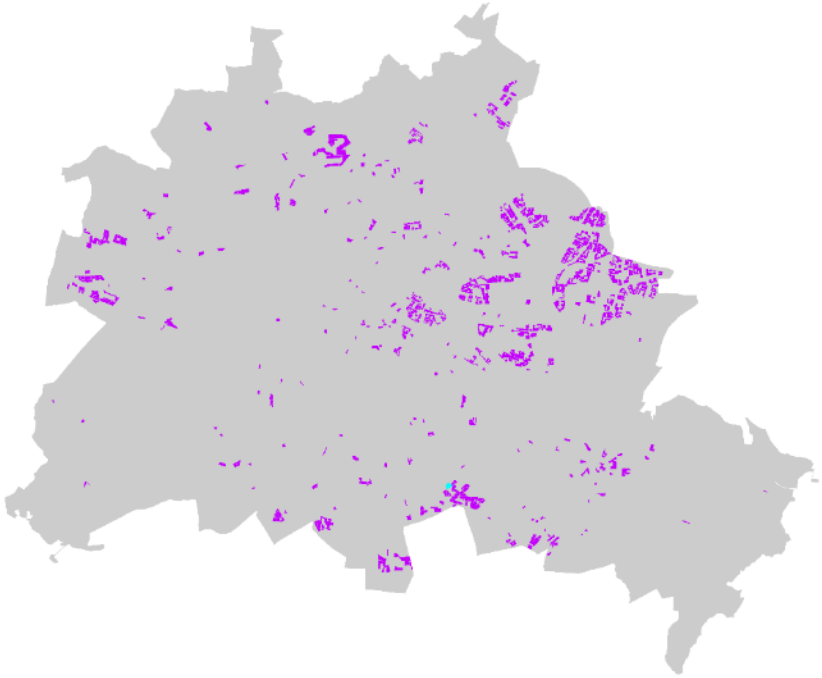
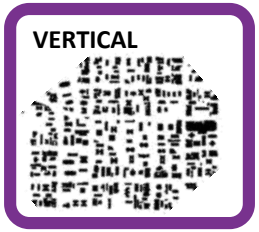

EDGE

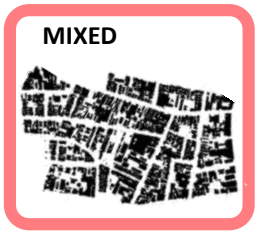

HALF-OPEN


MODERN




HORIZONTAL


VERTICAL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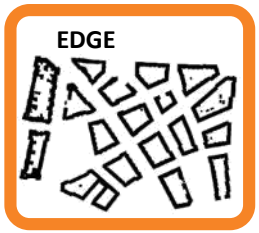
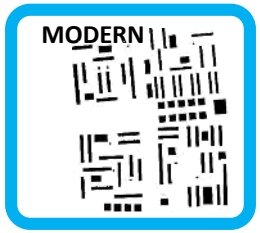
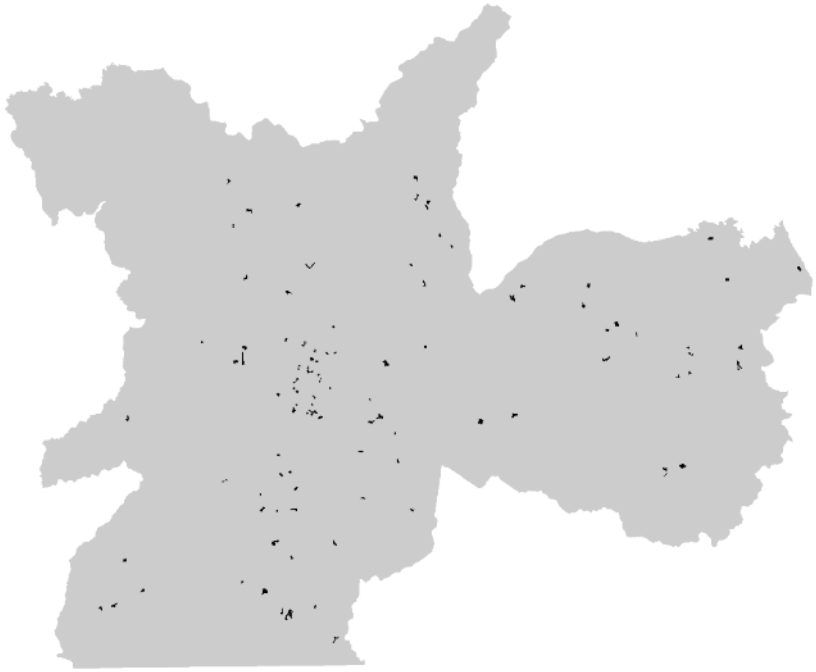

EDGE


HALF-OPEN

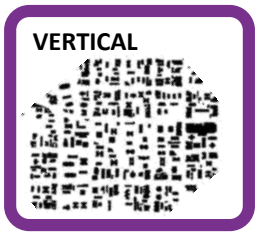

MODERN


CONTEMPORARY



SAMPLES


HORIZONTAL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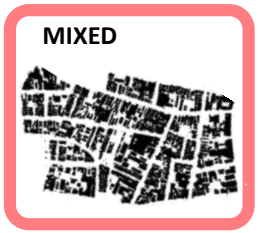
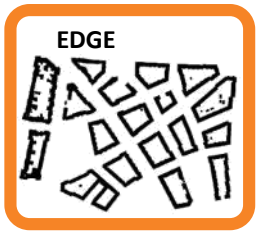
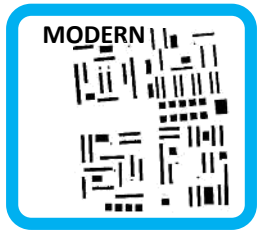

MIXED


TRADITIONAL

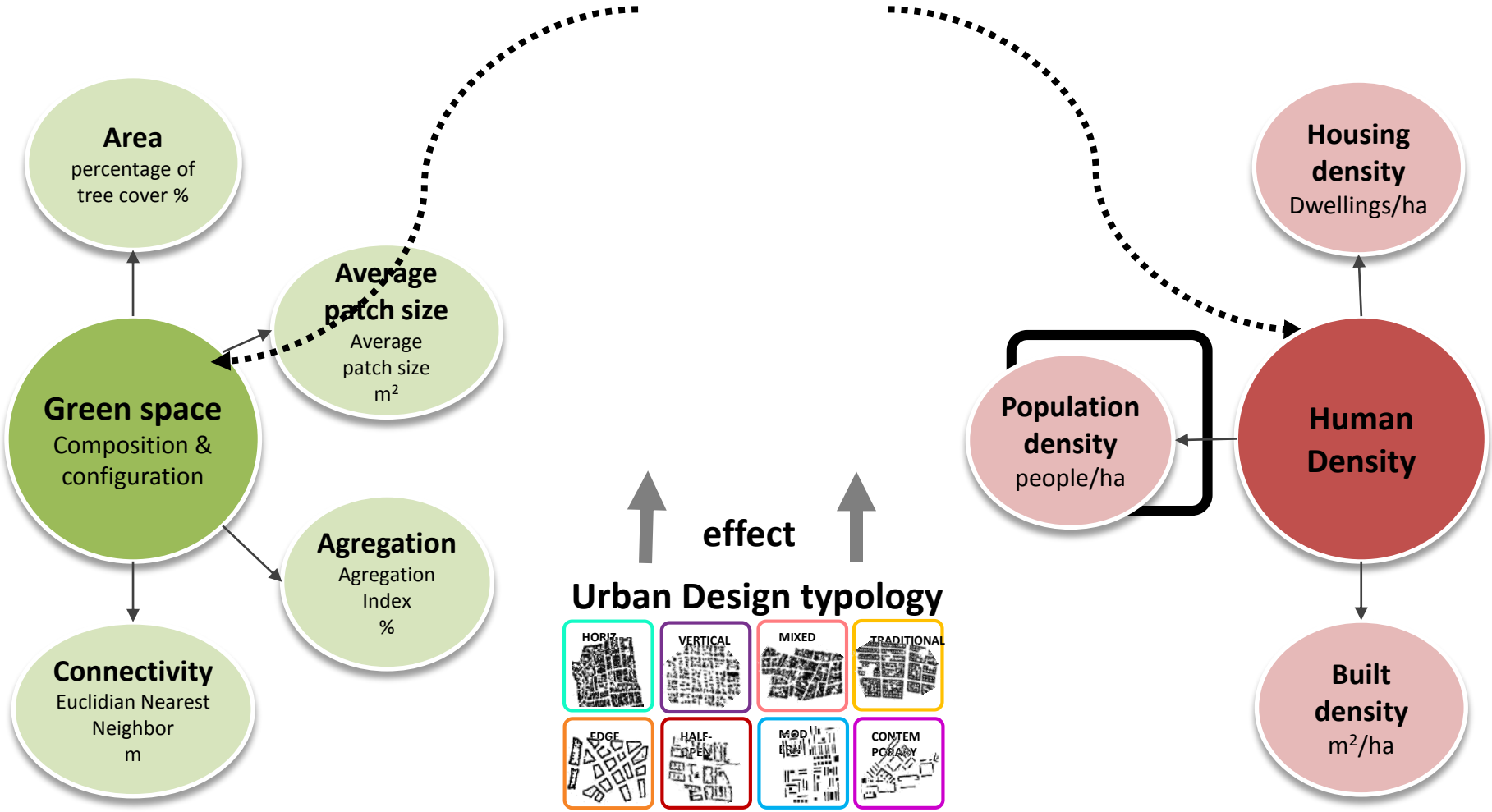

EDGE


HALF-OPEN

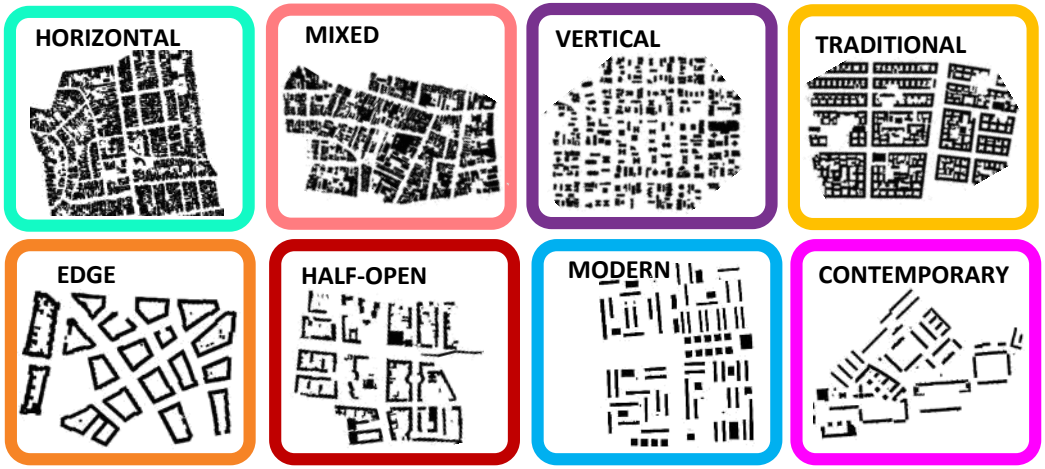

MODERN

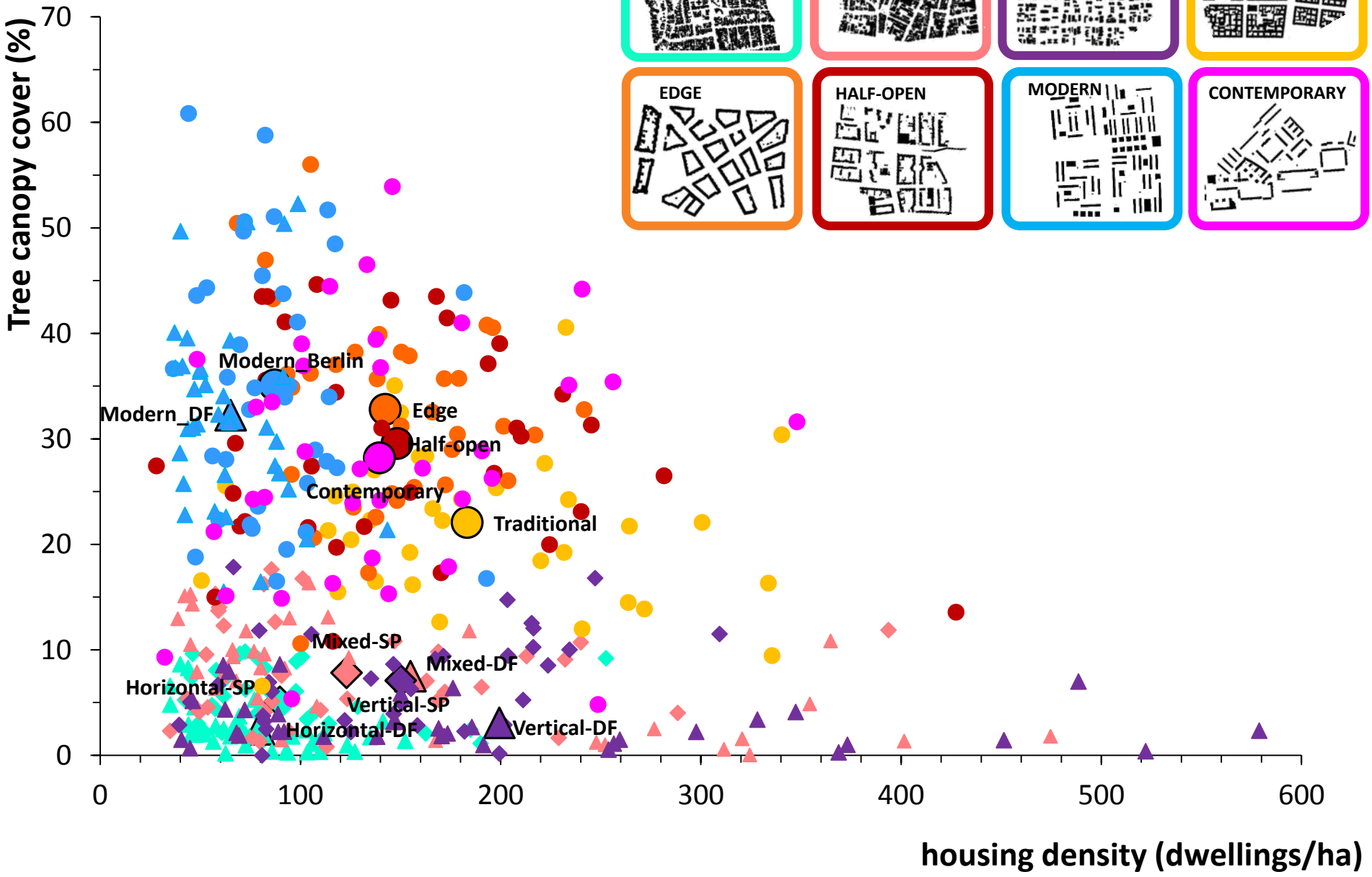

CONTEMPORARY

What measure?

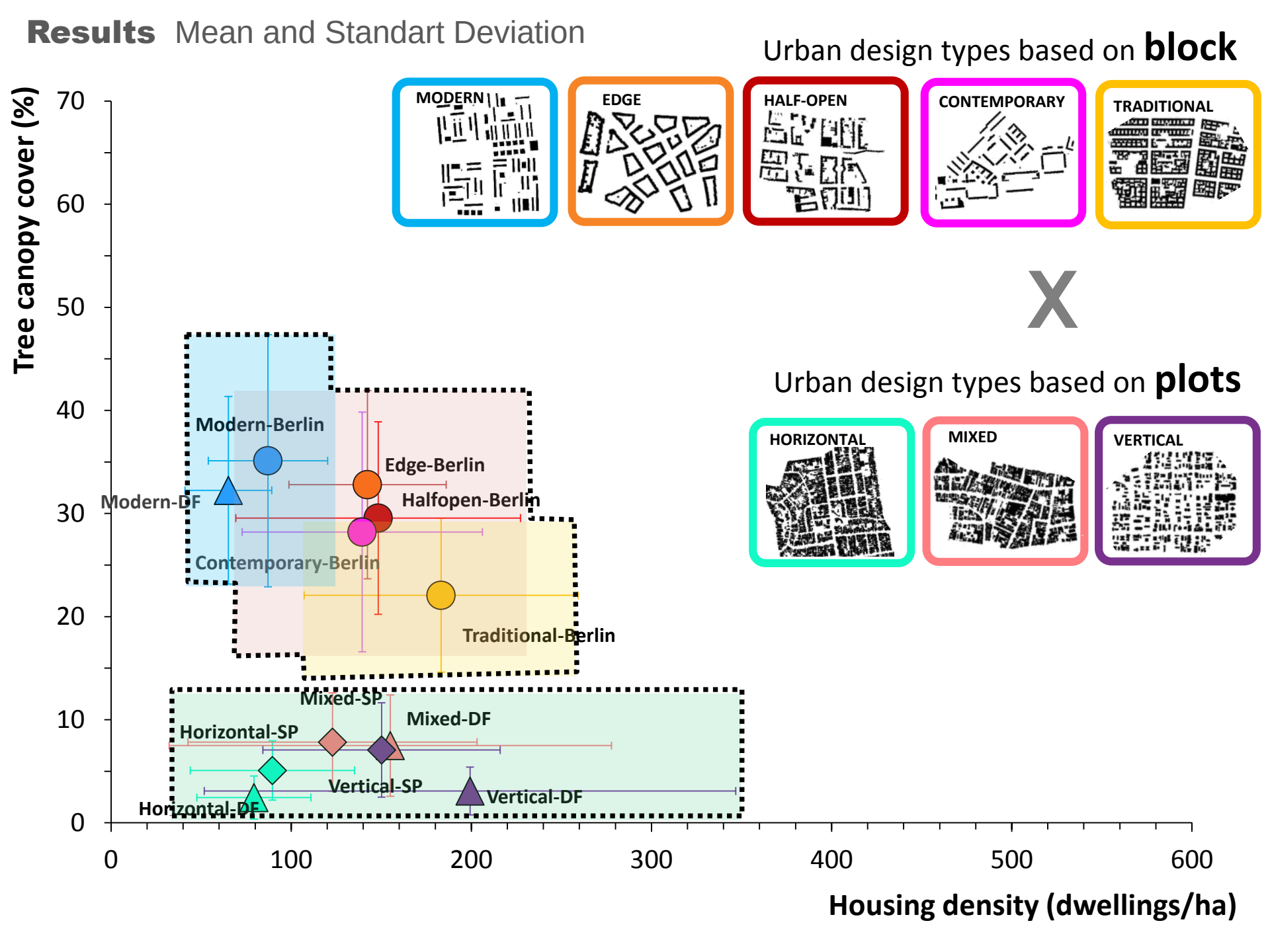


Results

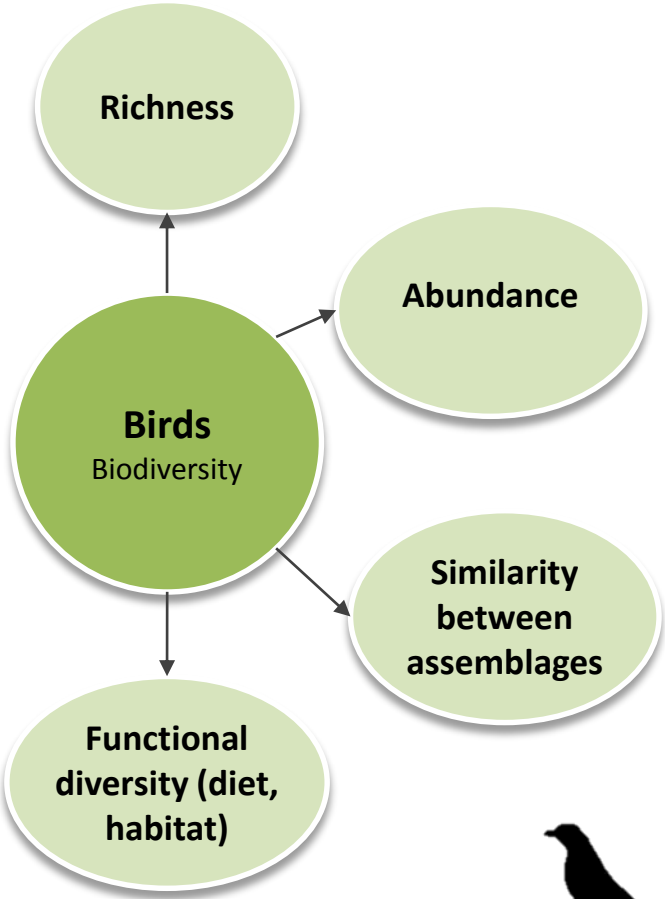

HORIZONTAL
MIXED
VERTICAL
TRADITIONAL
EDGE
HALF-OPEN
MODERN
CONTEMPORARY


Tree canopy cover (%)
70
60
50
40
30
20
10
0
0
100
200
300
400
500
600
housing density (dwellings/ha)
Modern_Berlin
Modern_DF
Edge
Half-open
Contemporary
Traditional
Mixed-SP
Mixed-DF
Horizontal-SP
Vertical-SP
Horizontal-DF
Vertical-DF

Results Mean and Standart Deviation



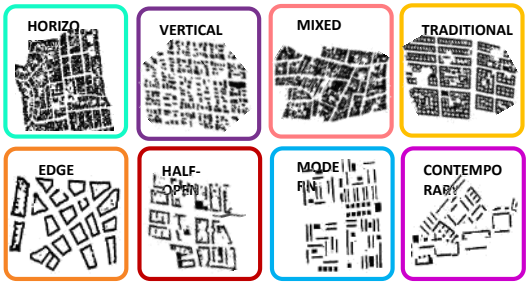
What more we measured?



Bird survey

analyze

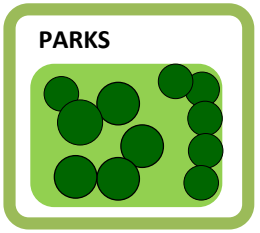
Urban Design typology



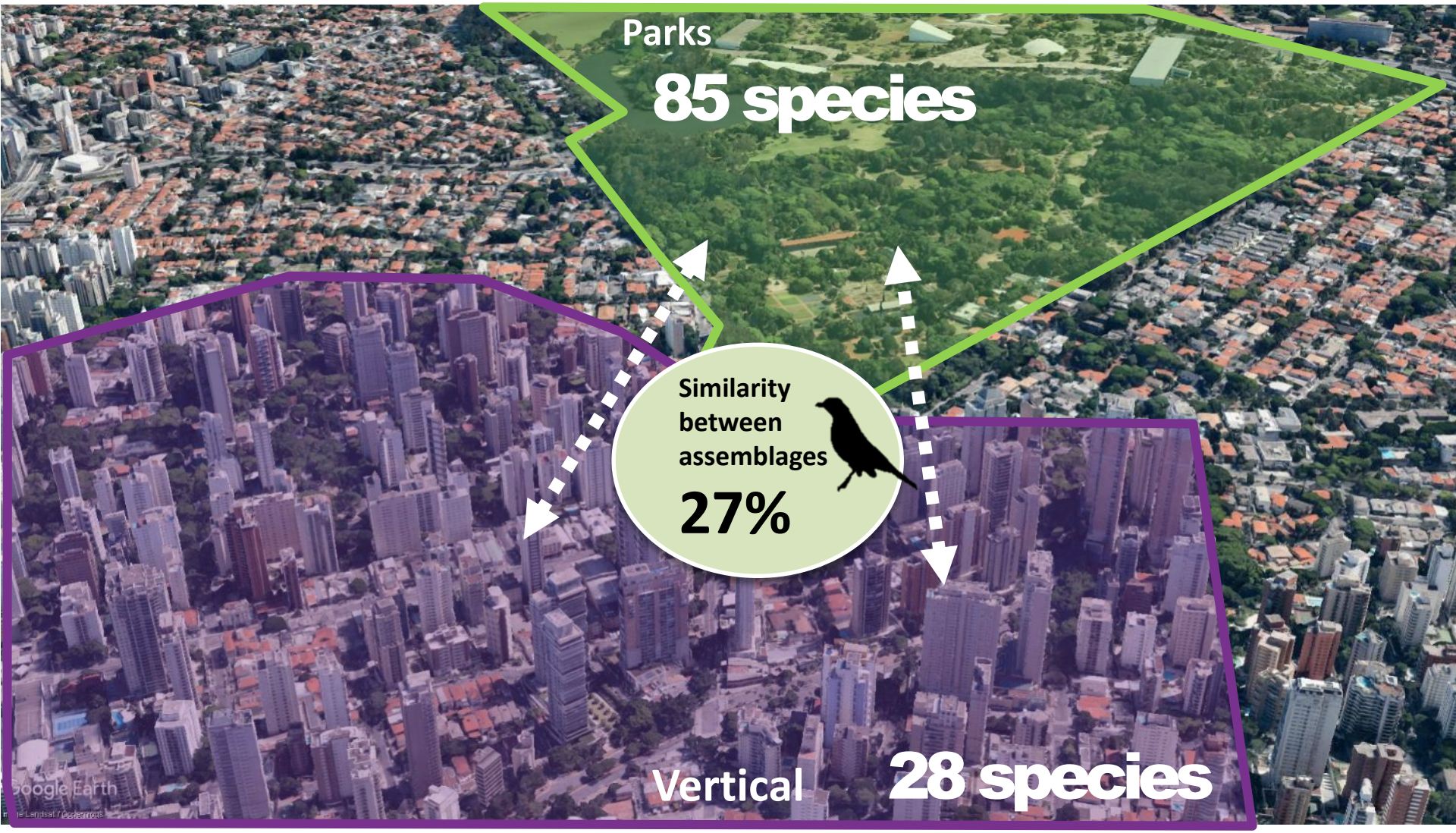
matrix contrast

X

Reference areas

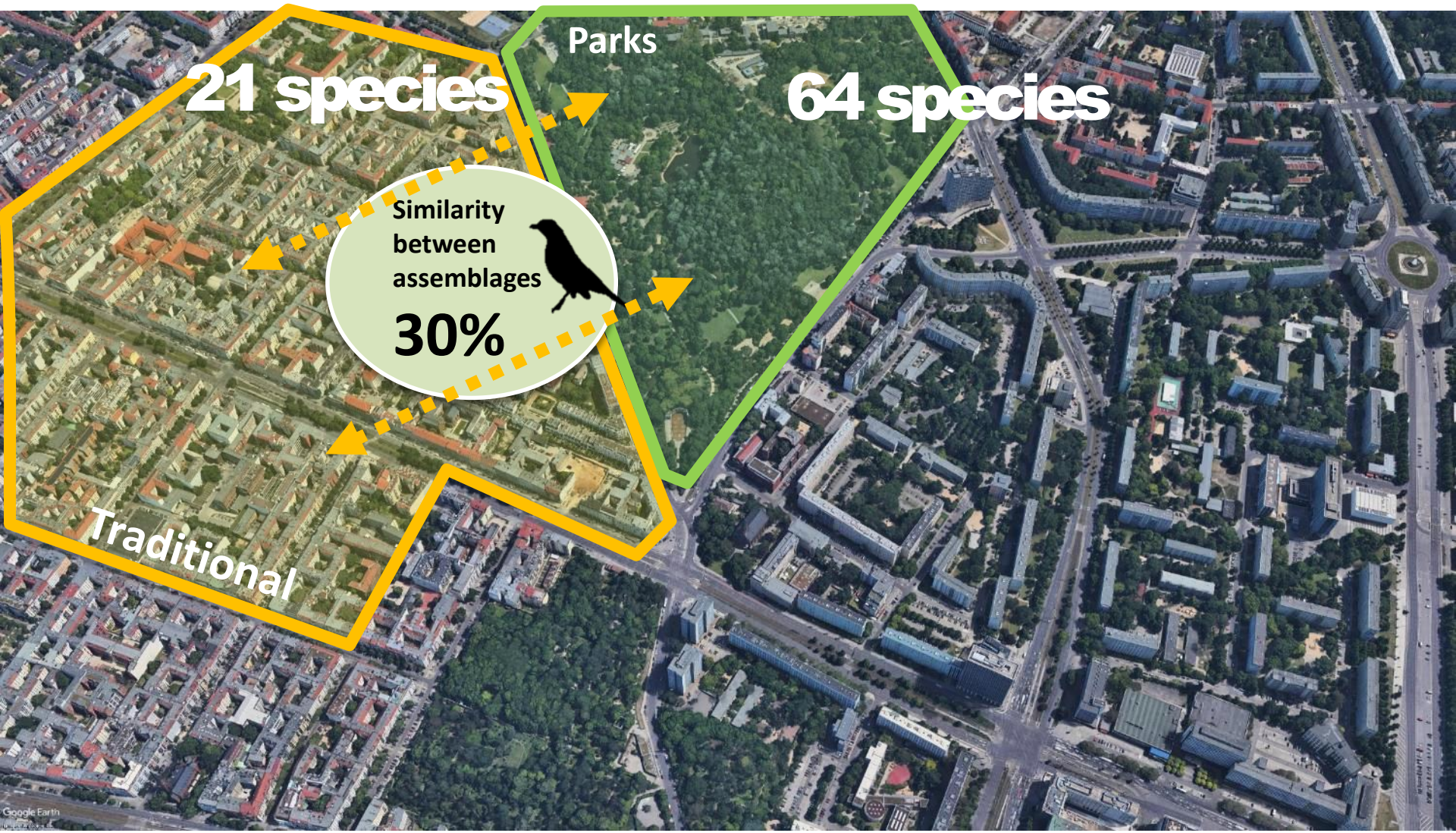


São Paulo



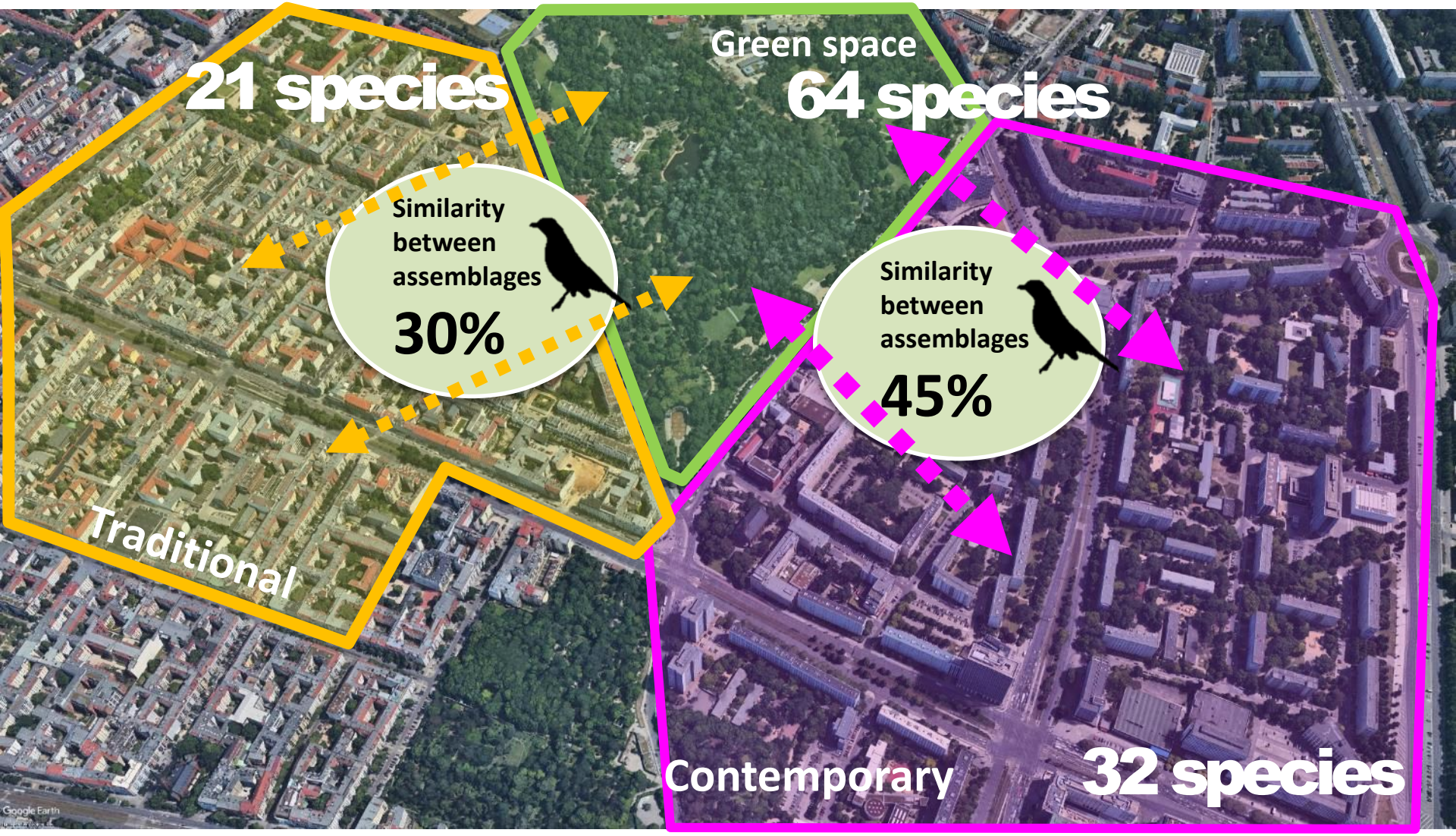
= **Low matrix permeability**

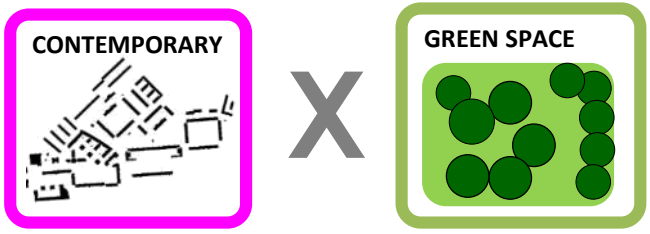
Berlin


21 species
Parks
64 species
Similarity between assemblages
30%
Traditional
Google Earth


TRADITIONAL
X
GREEN SPACE

Berlin





Higher urban matrix permeability
Variety of resources (natural / anthropogenic)

Conclusions

Housing density

Tree canopy cover

HORIZONTAL

ERN (OPEN BLOCK)

Urban design is a“green” key to build more sustainable and resilient cities

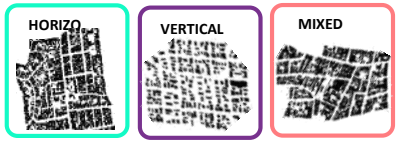
84 dwellings/ha

3,7%

76 dwellings/ha

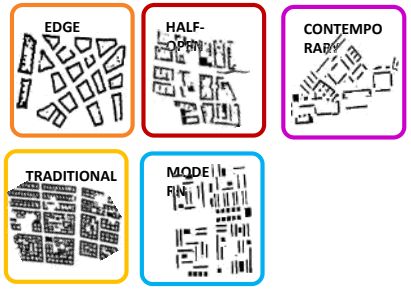
33,6%

Conclusions



Urban design based on **plots**

X



Urban design based on **block**

Higher probability to achieve a greater tree cover

Why?

more control by setting rules/guidelines over the composition& configuration of green spaces = greater efficiency

Ps. The research is underway, as we are working in a multivariated database with several metrics related to vegetation, density and biodiversity

Acknowlegdements

Team



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Institutions

Funding

Supporters and Collaborators

Extra slides

(in case of questions)

VERTICAL (HIGH-RISE TOWERS)

Bairro Higienópolis, São Paulo

Fonte: GoogleEarth Pro

Bairro Moema, São Paulo

Fonte: GoogleEarth Pro

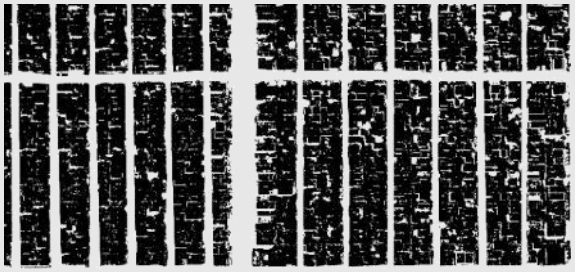
Urban development	High-rise towers isolated in the plot with setbacks in all sides
Storey number	From 4 to 41 storeys
Configuration on the block	Fragmented and individual
Permeability	Predominantly sealed soil (underground car parking)
occurrence	São Paulo and Federal District(Águas Claras)

HORIZONTAL (DETTACHED OR ATTACHED HOUSES)

Bairro da Penha, São Paulo

Fonte: Google Earth Pro

Ceilândia, Distrito Federal



Fonte: Google Earth Pro

Urban development	Dettached or attached houses, low-rise buildings with or without setbacks
Storey number	From 1 to 3 storeys (< 11m)
Configuration on the block	Fragmented and individual
Permeability	Predominantly sealed soil (car parking on the ground level)
Occurancy	São Paulo and Distrito Federal (Ceilândia, Guará, Taguatinga, Samambaia)

MIXED

V.Mariana, São Paulo

Fonte: Google Earth Pro

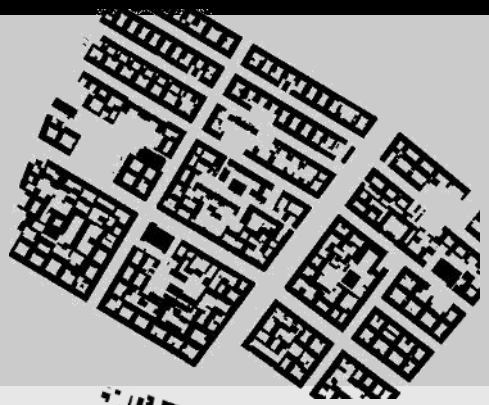
Bairro Moema, São Paulo

Fonte: Google Earth Pro

Urban development	Horizontal and vertical buildings
Storey number	From 1 to 41 storeys
Configuration on the block	Fragmented and individual
Permeability	Predominantly sealed soil (car parking on the ground and undergroung)
Occurancy	São Paulo and Distrito Federal (Aguas Claras)

TRADITIONAL BLOCK – CLOSED AND COMPACT BLOCK

Winsviertel, Berlim



Fonte: Google Earth Pro

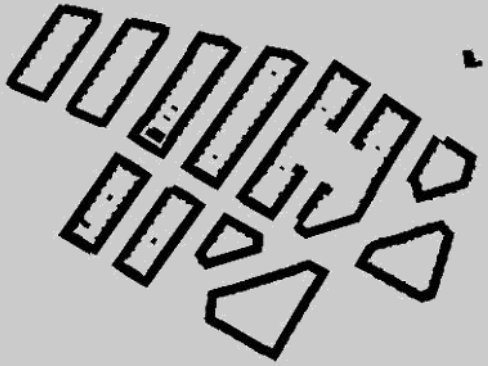
Bergmannkiez, Berlim

Fonte: Google Earth Pro

Urban development	Closed and compact block with continuous buildings facade aligned to street with small courtyards
Storey number	From 4 to 7 storeys
Configuration on the block	Perimetral block with some rear buildings in the meadle of the block
Permeability	Soil most sealed with parking areas or tiny gardens
Occurancy	Berlin

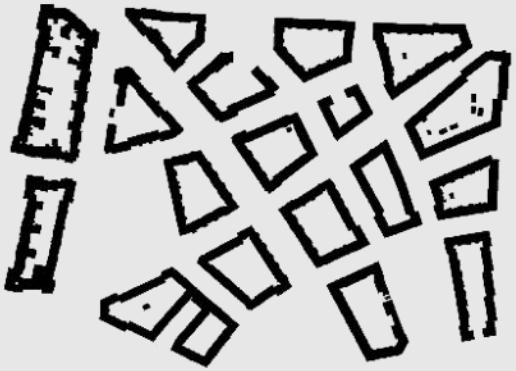
EDGE BLOCK

Helmholtzkiez, Berlim



Fonte: Google Earth Pro

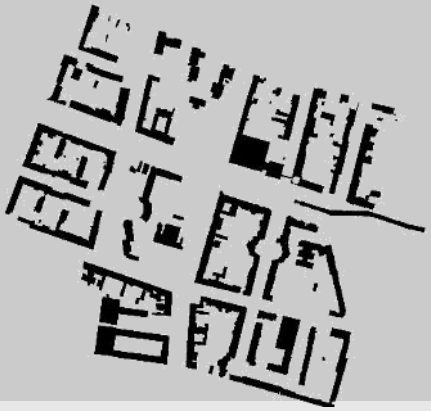
Friedenai Berlim



Fonte: Google Earth Pro

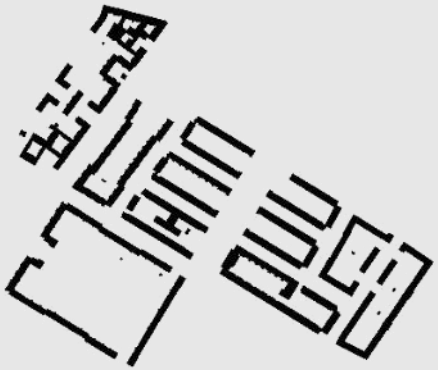
Urban development	Closed edge block with continuous buildings aligned to street grid with one-single large courtyard
Storey number	To 3 from 5 storeys
Configuration on the block	Perimetral / edge block
Permeability	Soil most permeable with external car parking
Occurancy	Berlin

HALF OPEN BLOCK



Tiergarten, Berlim

Fonte: Google Earth Pro

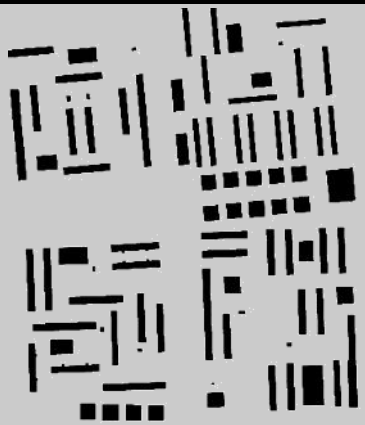


Helmholtzkiez, Berlim

Fonte: Google Earth Pro

Urban development	Semicontinuous buildings aligned to street grid with one single and large courtyard
Storey number	From 5 to 6 storeys
Configuration on the block	Perimetral / edge block with openings/access to courtyard
Permeability	Soil most permeable with external car parking
Occurancy	Berlin

MODERN



Brasília, Distrito Federal

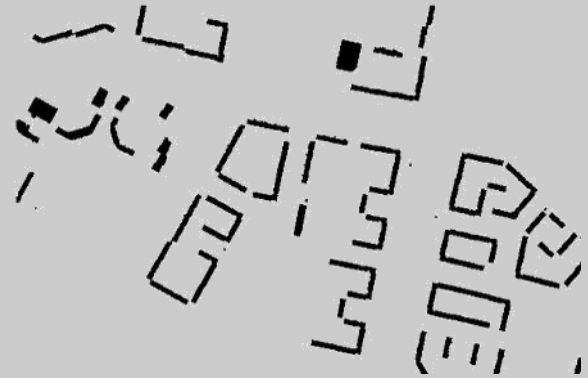
Fonte: Google Earth Pro

Charlottenburg Nord, Berlim

Fonte: Google Earth Pro

Urban development	Slab buildings not aligned to street grid in a open block
Storey number	From 3 to 6 storeys
Configuration on the block	Buildings are othogonally arranged
Permeability	Soil most permeable with car parking on the ground and underground
Occurancy	Berlin and Federal District (Brasília)

CONTEMPORARY



Marzahn, Berlim

Fonte: Google Earth Pro

Lichtenberg, Berlim

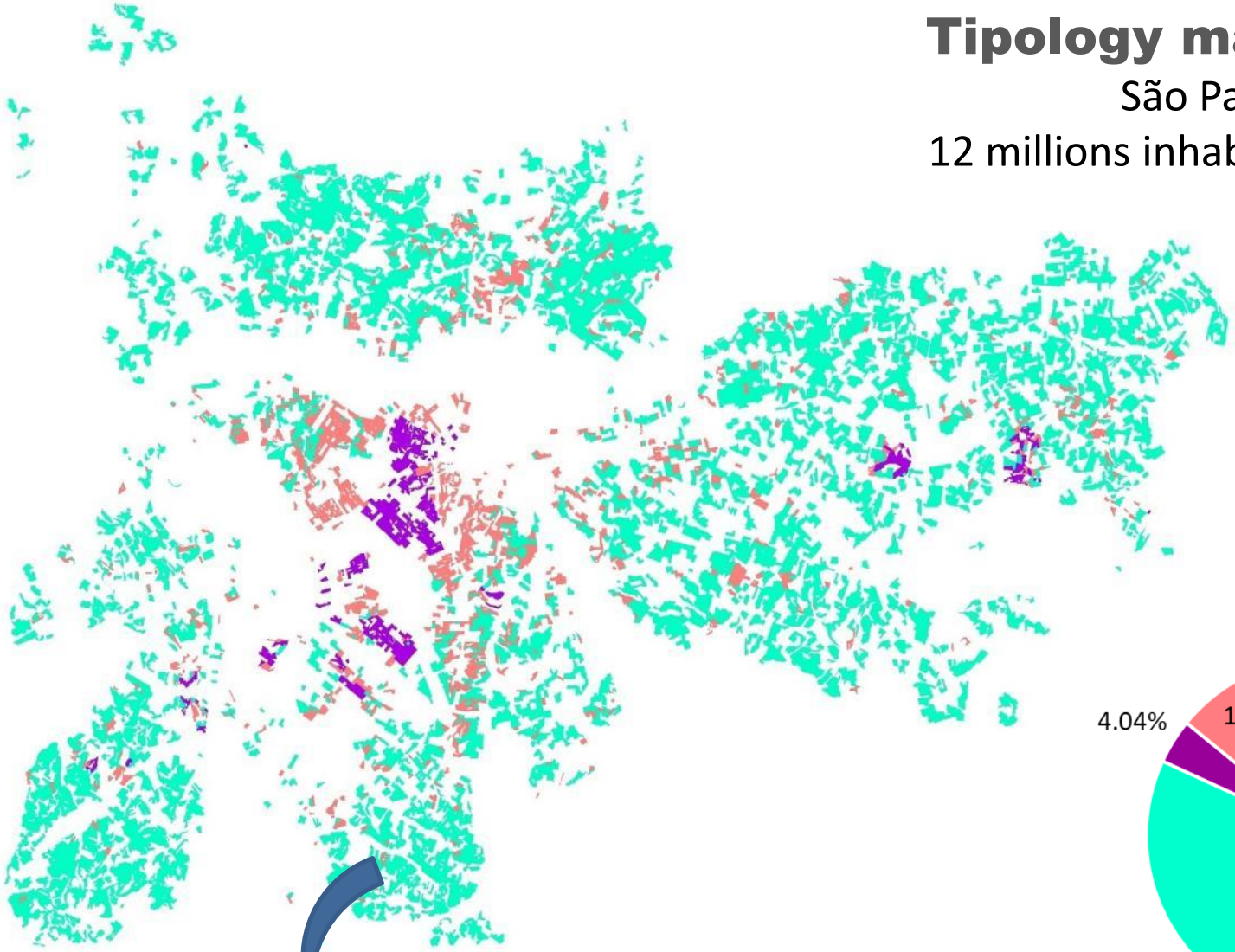
Fonte: Google Earth Pro

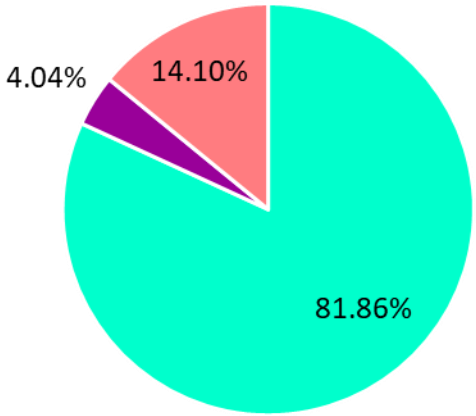
Urban development	Mixing of previous morphological types (vertical – towers, modern, halfopen block)
Storey number	From 3 to 28 storeys
Configuration on the block	Open and half-open block
Permeability	Soil most permeable with car parking on the ground level
Occurancy	Berlin

Tipology mapping result

São Paulo (census sector)

12 millions inhabitants (IBGE, 2016)





Sampling : 36 census sectors for each type

Types

- Horizontal
- Vertical
- Mixed

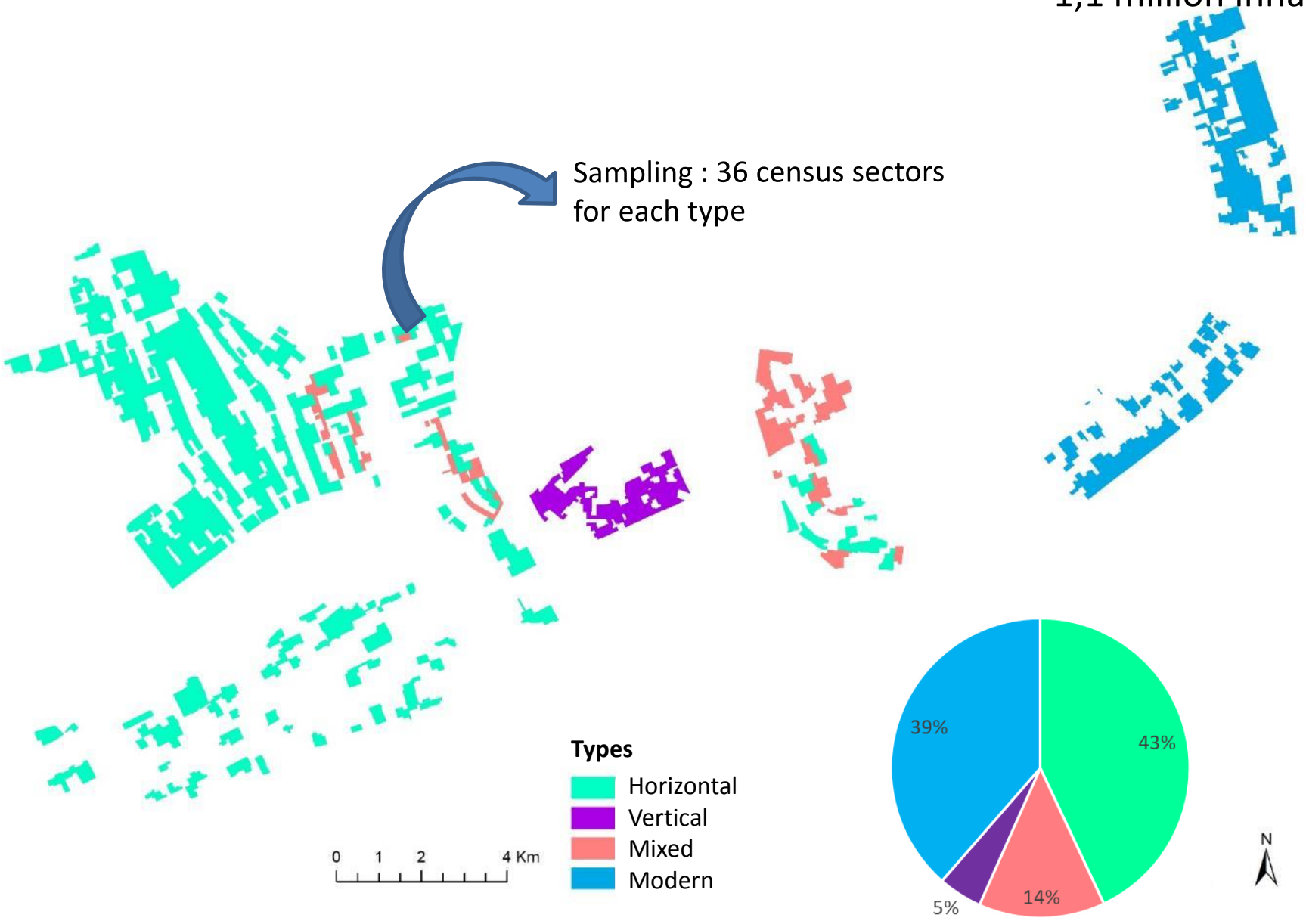
0 2,5 5 10 Km

N

Tipology mapping result

Federal District (census sector)

1,1 million inhabitants

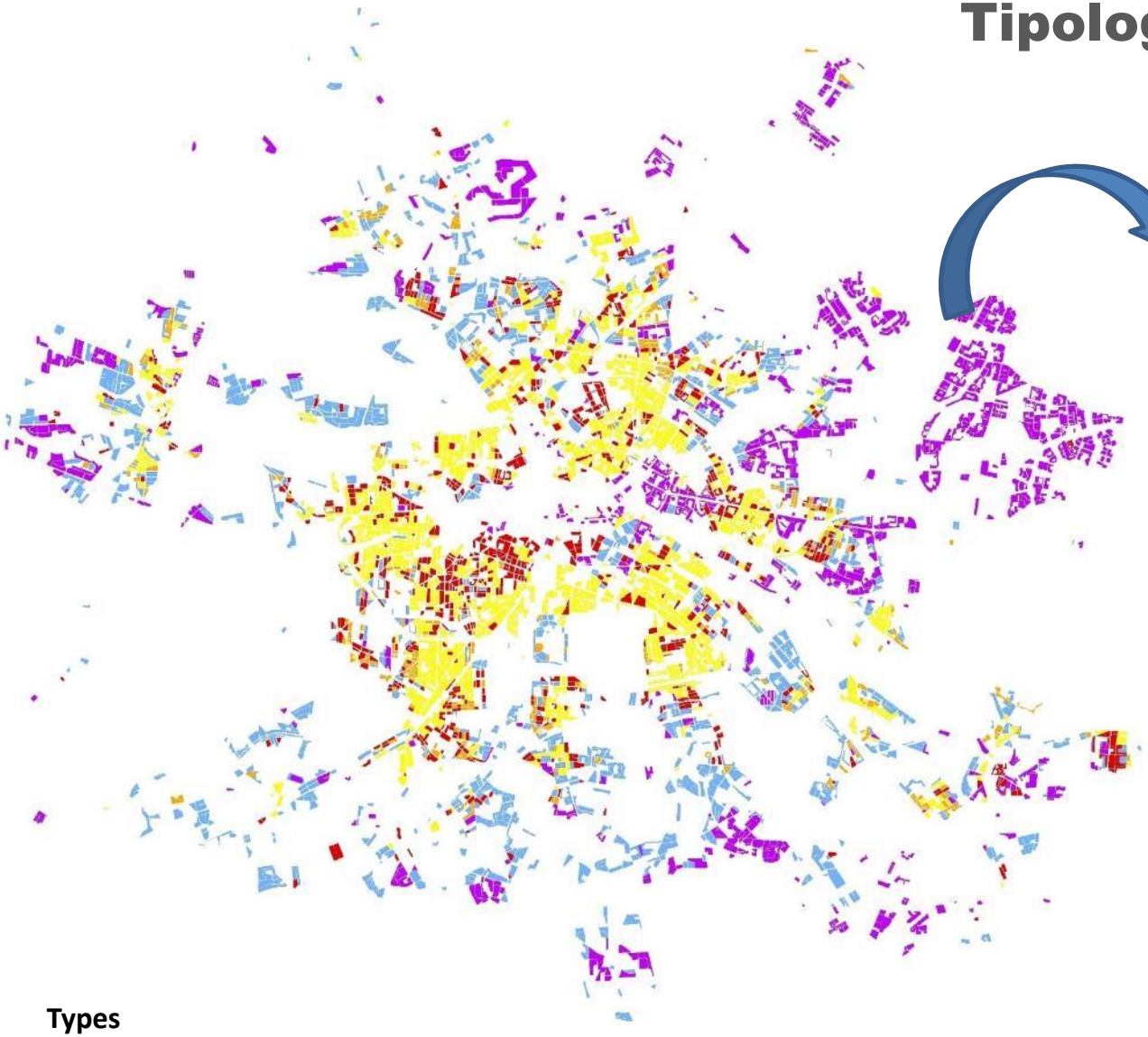


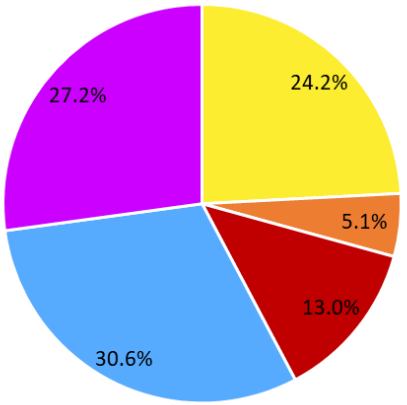
Tipology mapping result

Berlin (blocks)

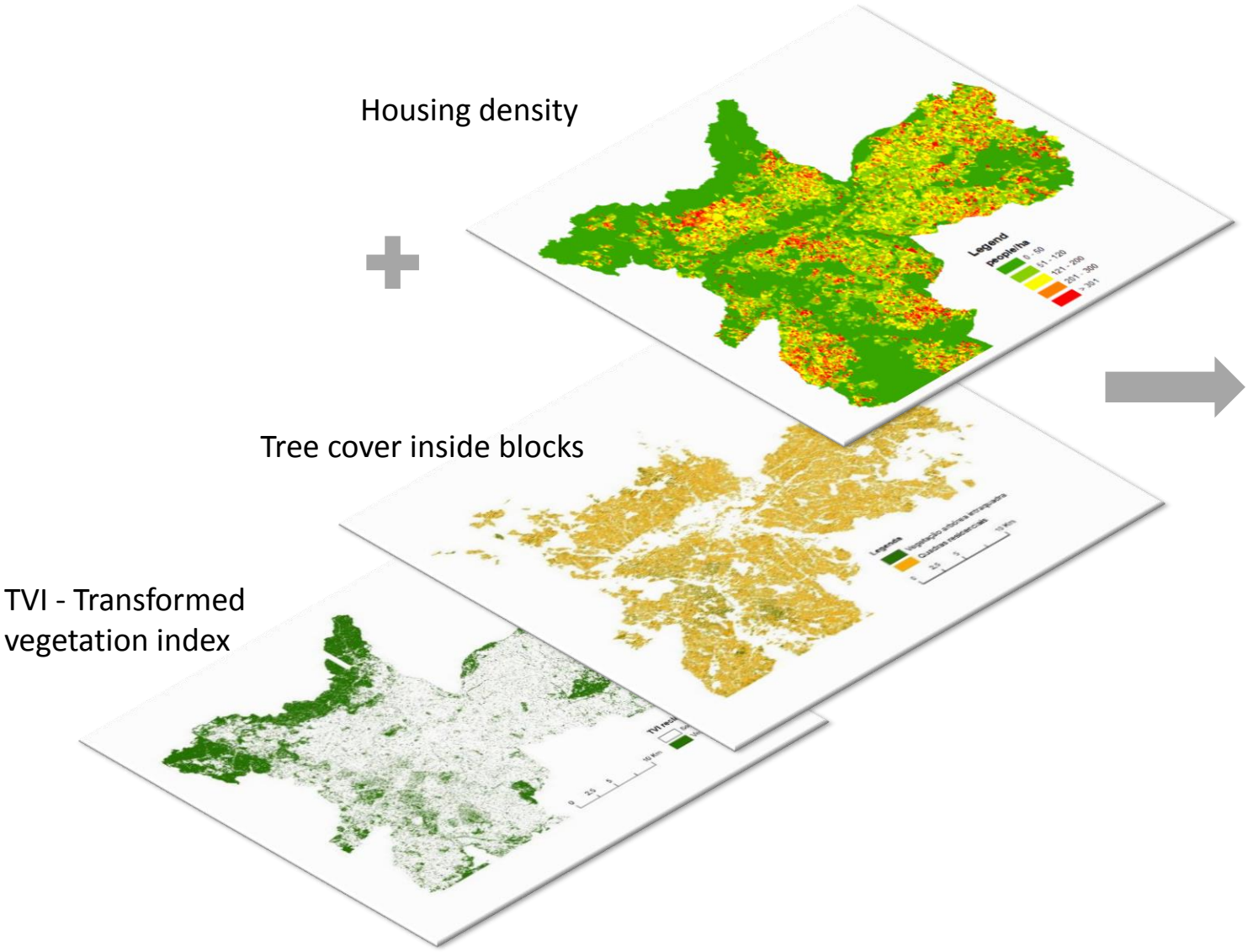
3,4 milion inhabitants

Sampling : 36 blocks for each type

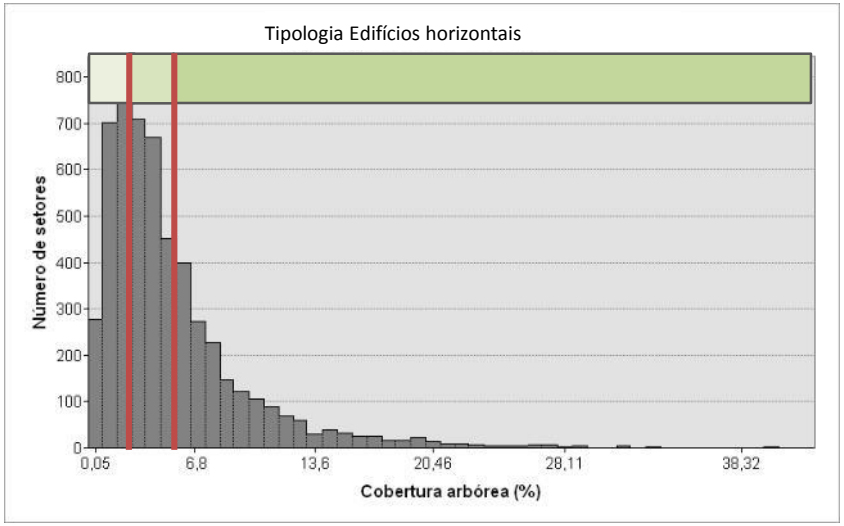


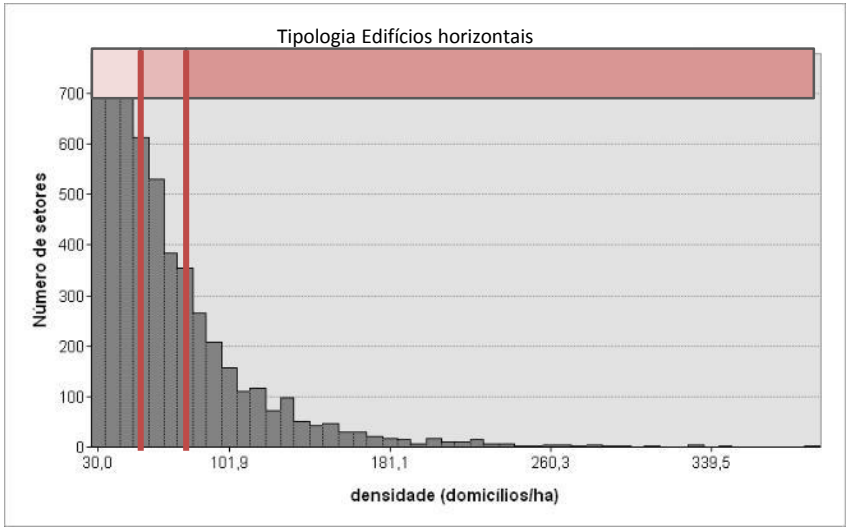


Sampling steps: São Paulo/ DF/ Berlim



Sample design





Divide by **quantiles**= range of a probability distribution into intervals with equal probabilities

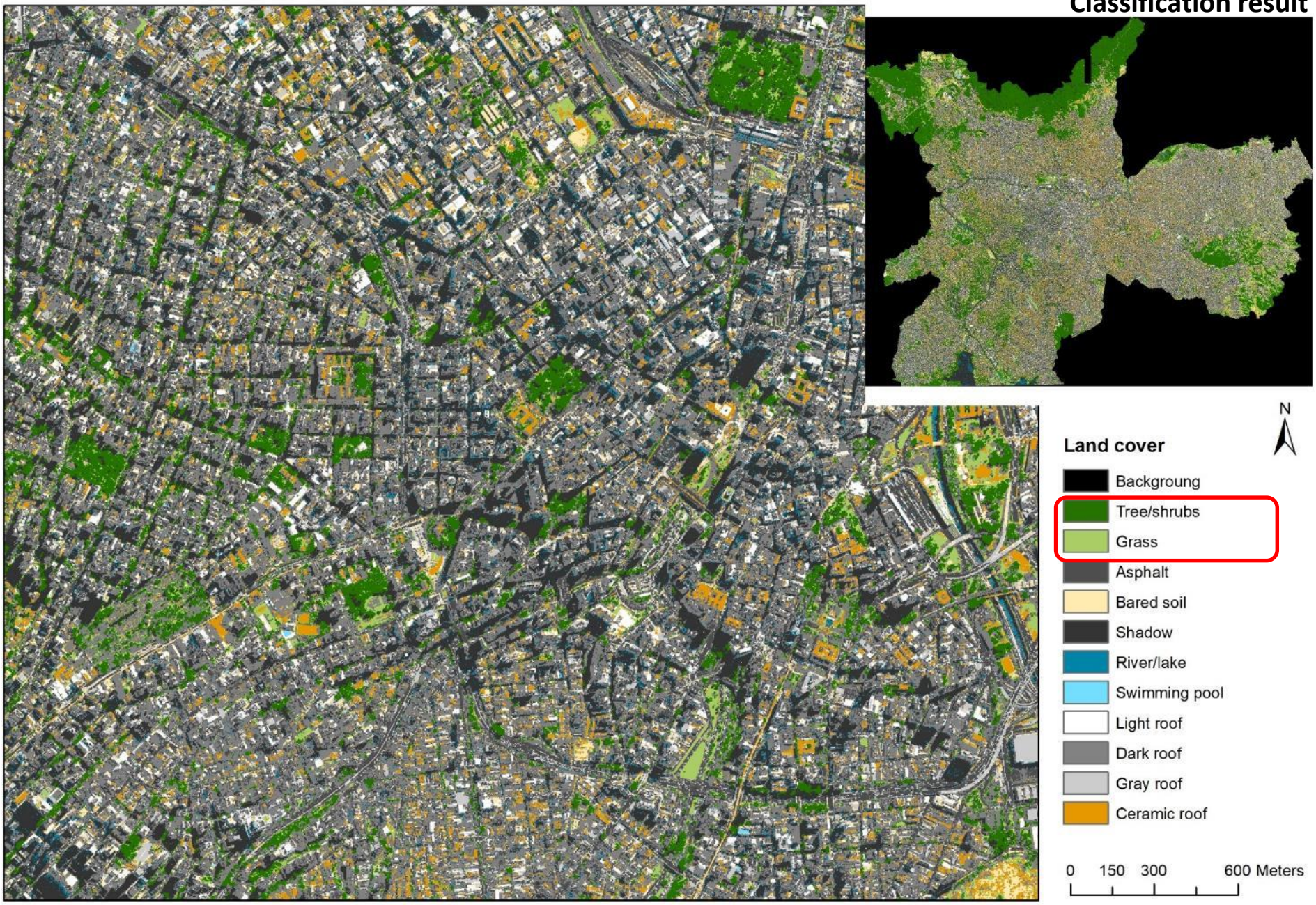
4 Random samples units in each level

Factorial design : 9 levels of combinantion

Housing Density (domicilio/ha) / Tree cover(%)	**4** (30.002199 a 47.768600)	**5** (47.768601 a 71.496300)	**6** (71.496301 a 389.924011)
1 (0 a 2.593260)	1-4	1-5	1-6
2 **(2.593261 a 5.098470)**	2-4	2-5	2-6
3 **(5.098471 a 68.662697)**	3-4	3-5	3-6

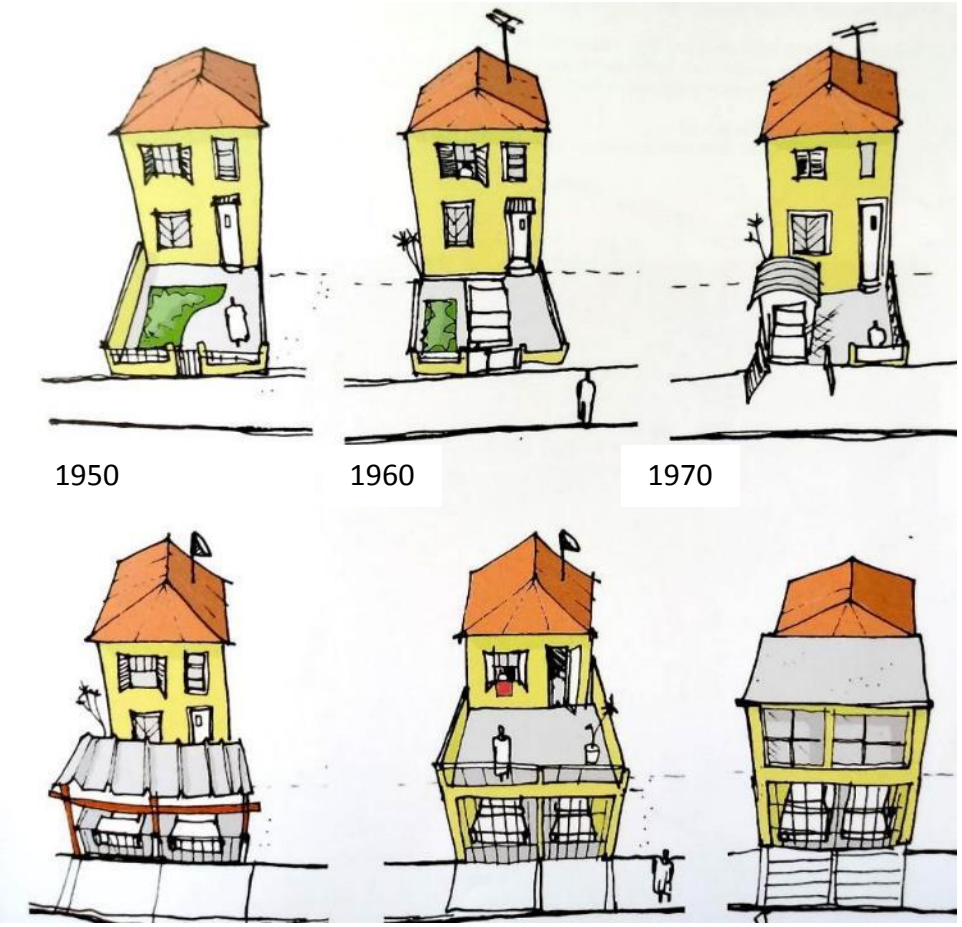
Total sample: 36 units

What kind of greenspace to measure in the samples?



Partial results

Conceptual temporal analysis of horizontal type in Brazilian cities (MACEDO, 2012; MAGNOLI, 1982)

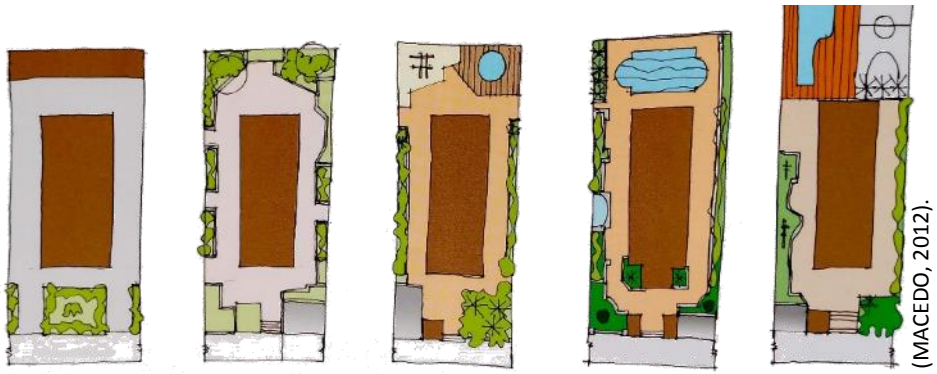


(MACEDO, 2012).

Horizontal-DF

Partial results

Conceptual layouts of vertical plot in Brazilian cities
(MACEDO, 2012)



(MACEDO, 2012).

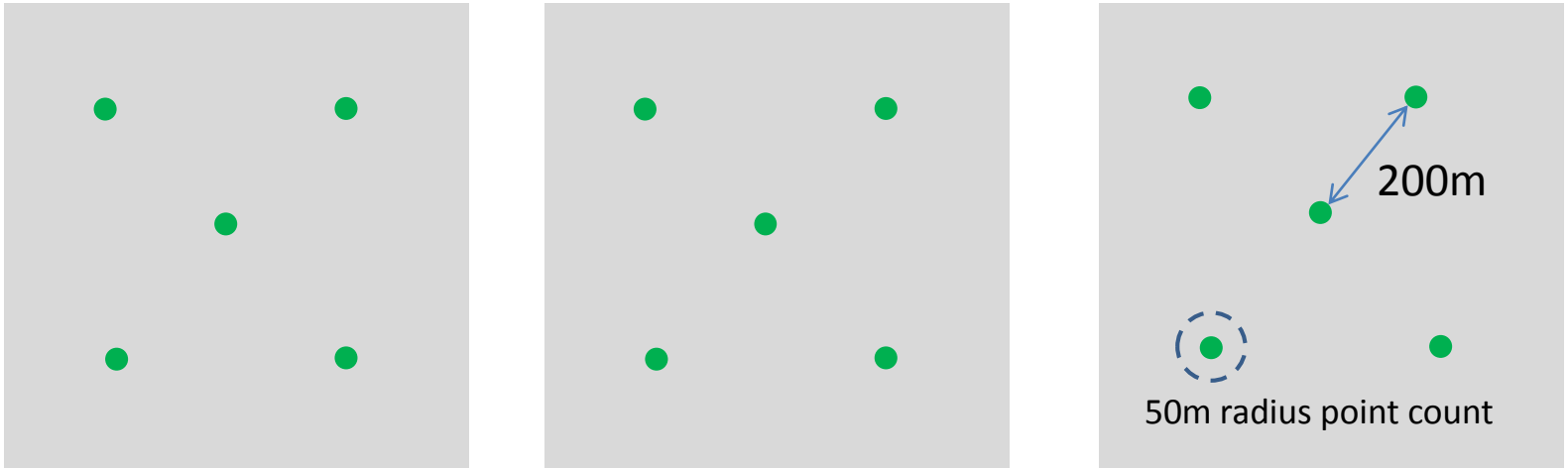
Small common green space and 1-3 levels of underground garage

Vertical-SP

EXPERIMENTAL DESIGN

3 URBAN TYPE SAMPLES AREAS

46,5 ha



Point count method

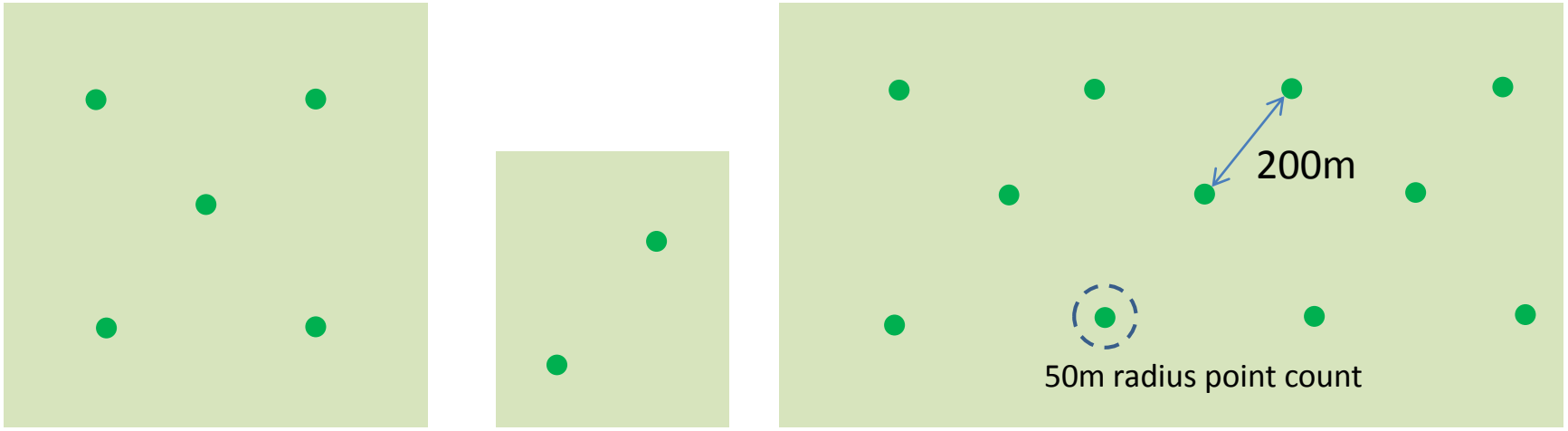
- ✓ **In each urban design type: 3 samples areas of approximately 46 hectares**
- ✓ **In each sample: 5 birds point counts with ≥ 200m distance between each other** (15 points each visit)
- ✓ **After 3 visits = 45 point counts in total in each typology**

Duration

- ✓ **10min in each point + time to move from point to another**
- ✓ **Early morning (sunrise)**

EXPERIMENTAL DESIGN

GREEN SPACE SAMPLES AREAS FOR REFERENCE



Point count method

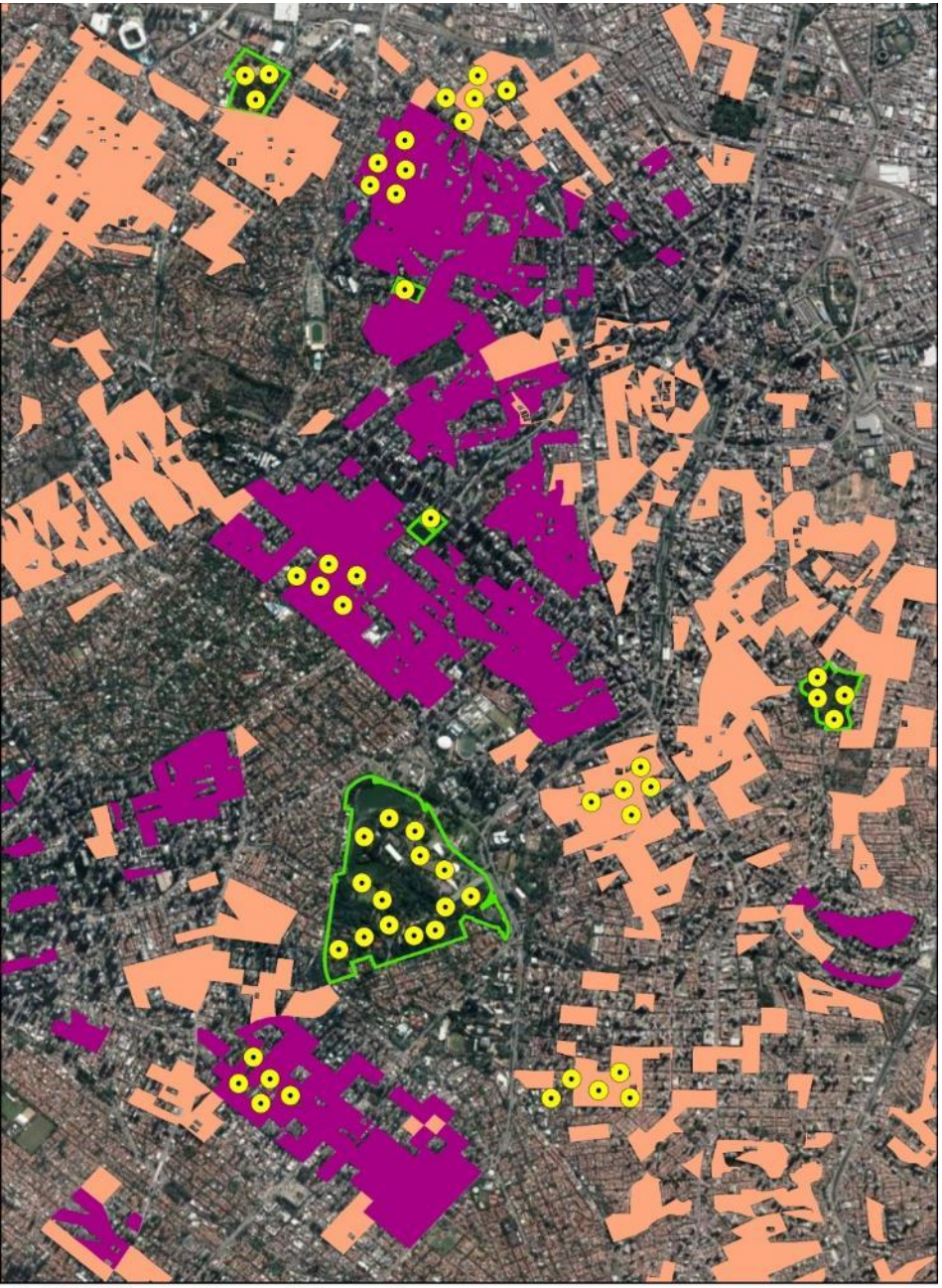
- ✓ **Reference areas > 2 ha**
- ✓ **500m up to 2000m of distance from urban samples**
- ✓ **At least 3 samples (but the number was variable between the cities)**
- ✓ **Number point counts was variable too, dependent of the size of each green space**
- ✓ **3 visits in each green space samples**

Duration

- ✓ **10min in each point + time to move from point to another**
- ✓ **Early morning (sunrise)**

São Paulo

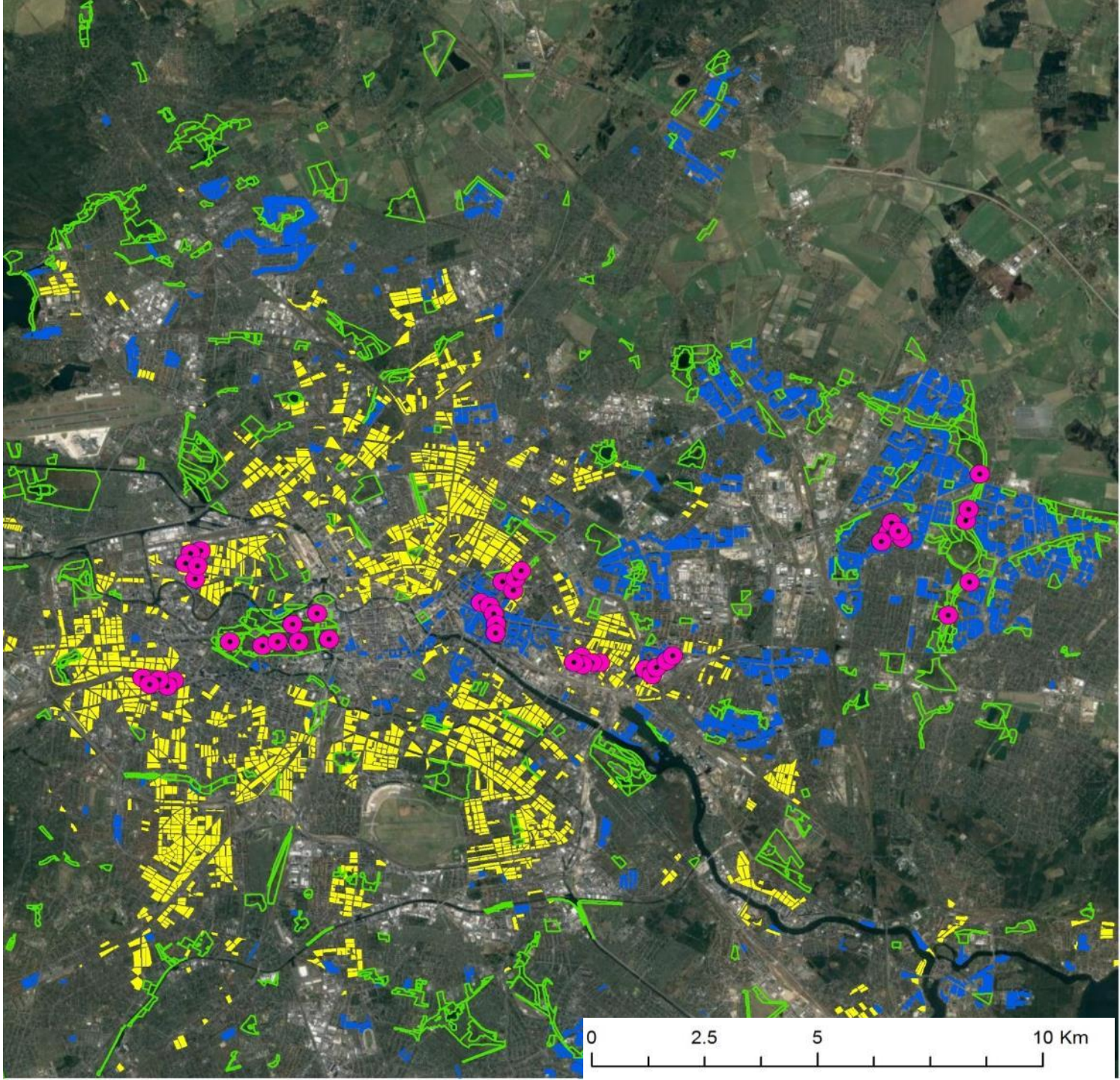
mixed Vertical

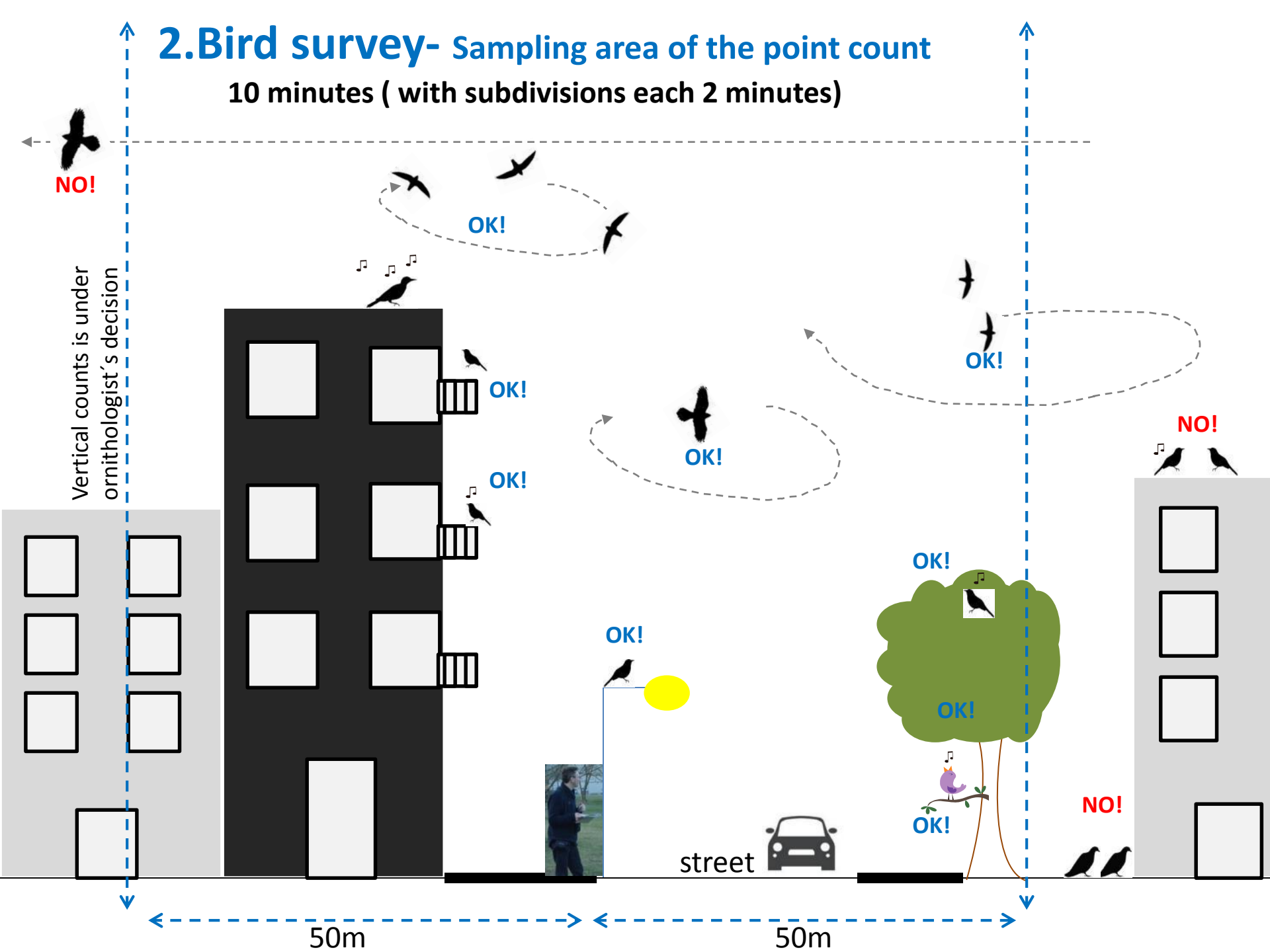


Brasília and Surroundings

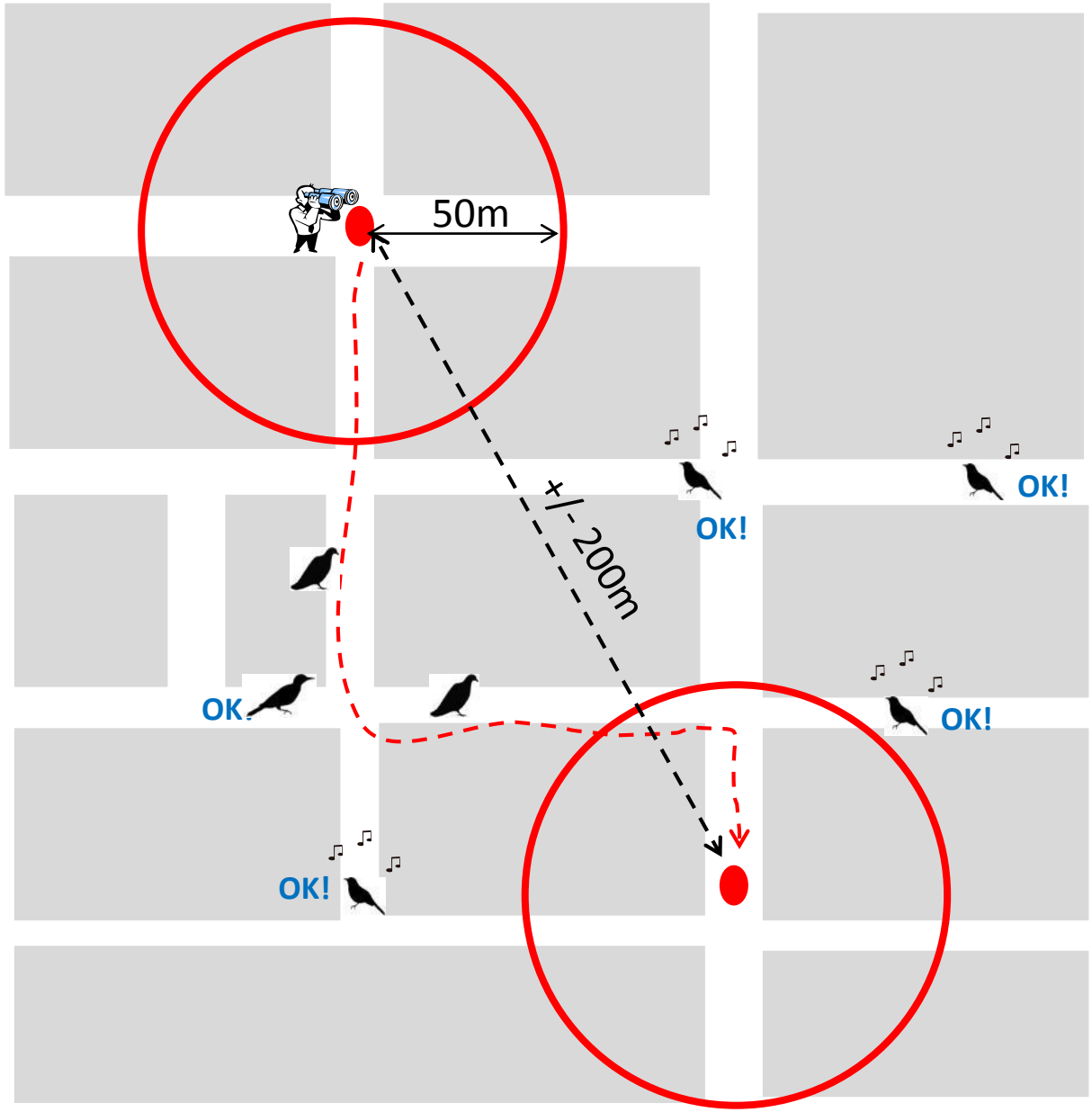
horizontal modern

Berlin




2.Bird survey- Sampling area of the point count
10 minutes (with subdivisions each 2 minutes)
NO!
OK!
OK!
OK!
OK!
OK!
OK!
OK!
OK!
NO!
NO!
Vertical counts is under ornithologist´s decision
street
50m
50m

Sampling between point counts – The complementary sampling



OK for qualitative data (i.e., bird species). Do not count bird individuals

BIRD SURVEY

3 visits in each point count / Only morning

Brazilian cities → Set - Nov/2017

Federal District

Prof. Ricardo Machado (University of Brasilia)

Berlin

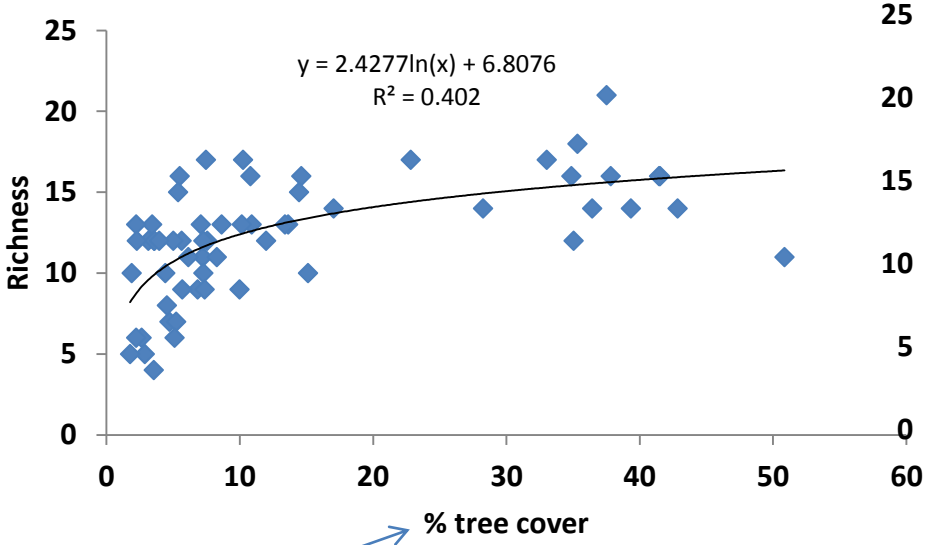
Apr – Jun/2018

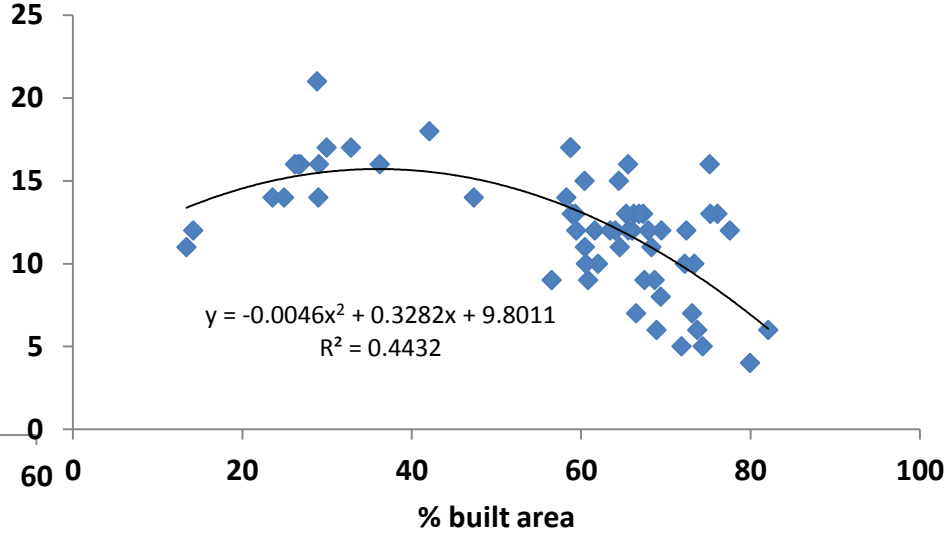
Ansgar Poloczek PhD student
(Humboldt)

São Paulo

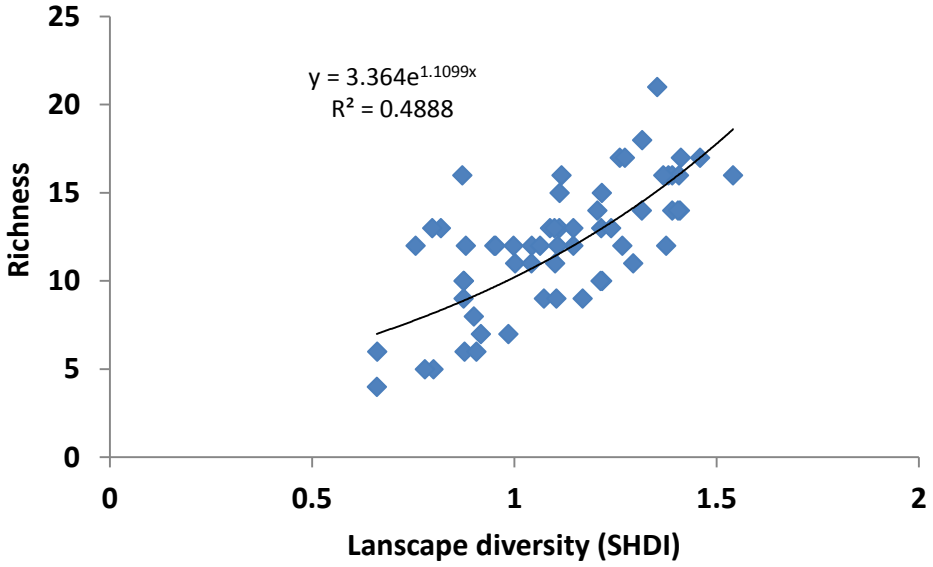
Marcos Melo PhD student
(Federal University of São Carlos)

Using only the data from urban types point count:



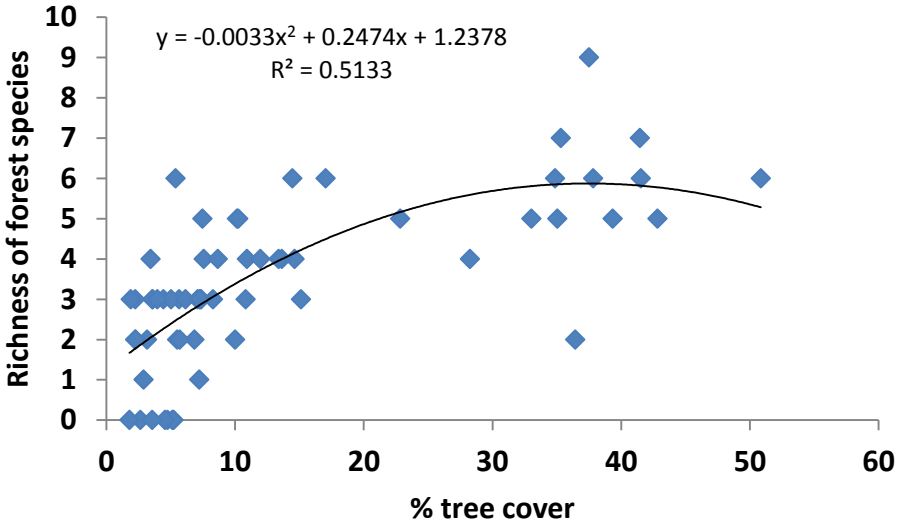


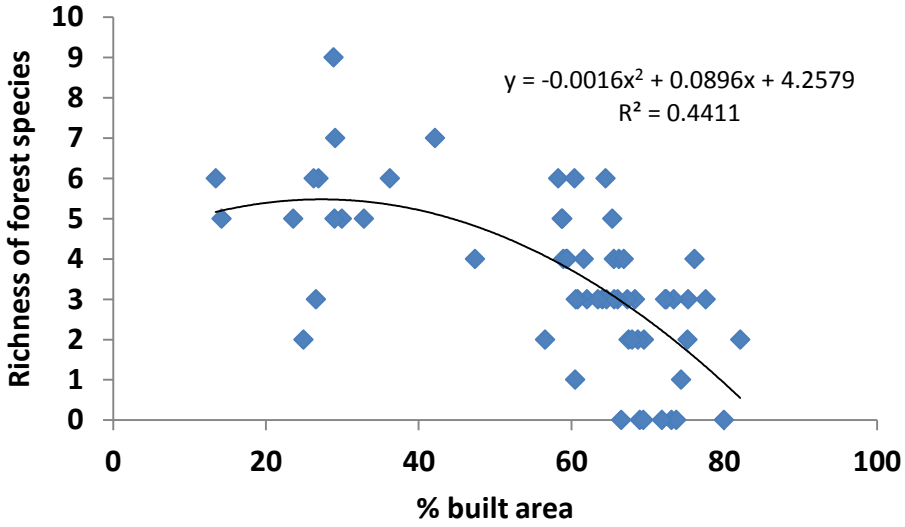
100m buffer around each point count



Using only the data from urban types point count:

Forest species:





Next steps:

- Start the analysis of Berlin bird data

- Explore/test other ecological indicators to be used as depended variable

Classify each bird on:
- Avoiders
- Utilizer
- Dwellers

" responses of each bird on urbanization rates"

Fischer, J. D., Schneider, S. C., Ahlers, A. A., & Miller, J. R. (2015). Categorizing wildlife responses to urbanization and conservation implications of terminology. *Conservation Biology*, *29*(4), 1246-1248.

To do that → Necessary improve the pixel-based classification

Bird occupation model → develop it for each city

Pedro Leitão will help us