Bridging European Urban Transformations (Research & Policy-in-Action):

Unplugging Big Data for Smart City-Regional Governance Workshop

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RESOLUTION

REsilient Systems fOr Land Use TransportatION

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E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

FAPESP SÃO PAULO RESEARCH FOUNDATION

Outline

RESOLUTION Project

Project team, objectives, challenges, assumptions. I will also tell you what the project is NOT about

Comparison of metropolitan areas

Introduction to São Paulo and London metropolitan areas, challenges of comparing those two cities

Segregation and Acessibility analysis

Challenges, preliminary results, comparability, fun parts.

Next steps (and hopes!)

for the project and beyond

RESOLUTION Project

- The REsilient Systems fOr Land Use TransportatION Project explores the impacts of unequal access to transport on different social groups in the metropolitan areas of London and São Paulo.
- Through a comparative study of these two world cities, the project aims to identify similarities and differences between them to tease out the broader social implications of transport access on mobility, segregation and other trends. The research looks into how resources are distributed depending on class, ethnicity and income.
- We hope the results will be of relevance to a range of stakeholders, including policy makers, academics and planners, working on improving opportunities for marginalised groups through more equitable transport systems.
- As the focus is comparative and global, the findings will have broader implications not only for London and São Paulo but also other large cities facing the same challenges.

Project objectives

Overall objective is to produce a generic system for exploring the impact of transportation on social segregation in the metropolitan areas of São Paulo and London.

More specifically, we aim to develop:

- a strong physical-functional measurement of accessibility across many spatial scales with focus on relationships to poverty and inequality as reflected in the segregation and polarisation of different social groups. This also includes a detailed study of spatial patterns of segregation.
- a simple model of residential segregation that relate to how changes in transportation exacerbate or reduce spatial segregation, locking in or out different populations from access to transport.

Assumptions

Maker or breaker?

We see transportation as a 'maker or breaker' of the city echoing the title of a famous paper by Colin Clark in the 1960s...

Transport is one of the most powerful tools available to transform urban systems due to its impact on population density, land use, land value and so on

There are a number of studies and models demonstrating this, amongst those the most recent CASA's one called QUANT (http://quant.casa.ucl.ac.uk/) where you can simulate the impact of changes in jobs on population as well as the impact of changes in the transportation system (such as crossrail and High Speed 2) in the UK.

Assumptions

To divide or conquer?

The main objective of transport system is to create and/or improve connections.

Naturally, one thinks of transport systems as promoters of integration, of providing accesssibility to people, connecting them to each other and to opportunities (jobs, health, education, entertainment)

However, in the reality of many developing countries cities transport is the very deal breaker of integration and often a promoter of segregation.

Our challenge

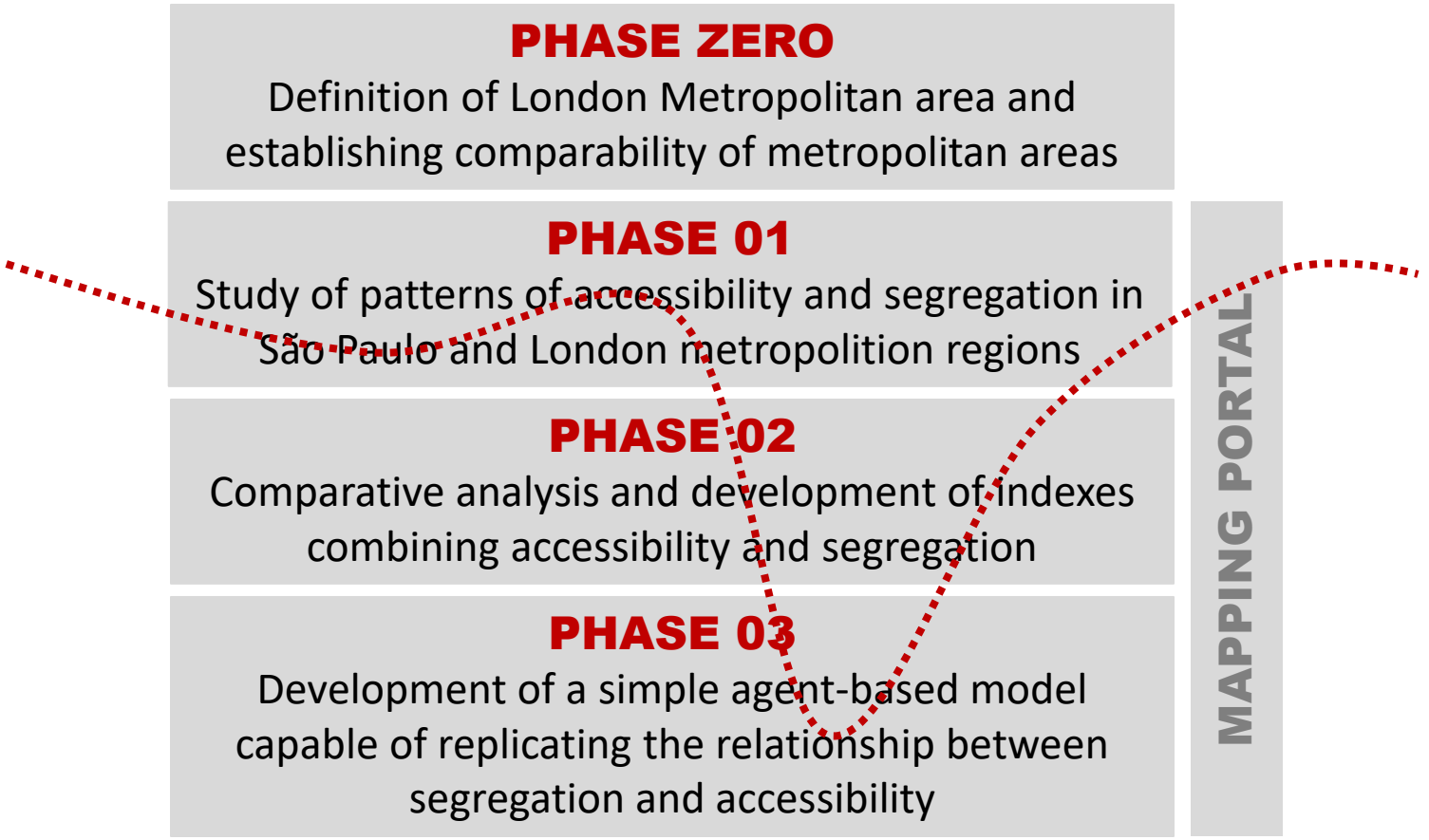
On one side we have London, a city known for its diversity, and on the other São Paulo, better known by its inequalities.

London also has inequalities and there is an argument those have increased in recent years, while poverty in Brazil has recentently decreased.

In this context, the challenge of the RESOLUTION project is to look at transport and segregation across two equally large but very different metropolitan areas using geospatial data and analytic tools.

Project phases

The project has been planned in 3 phases over two years:

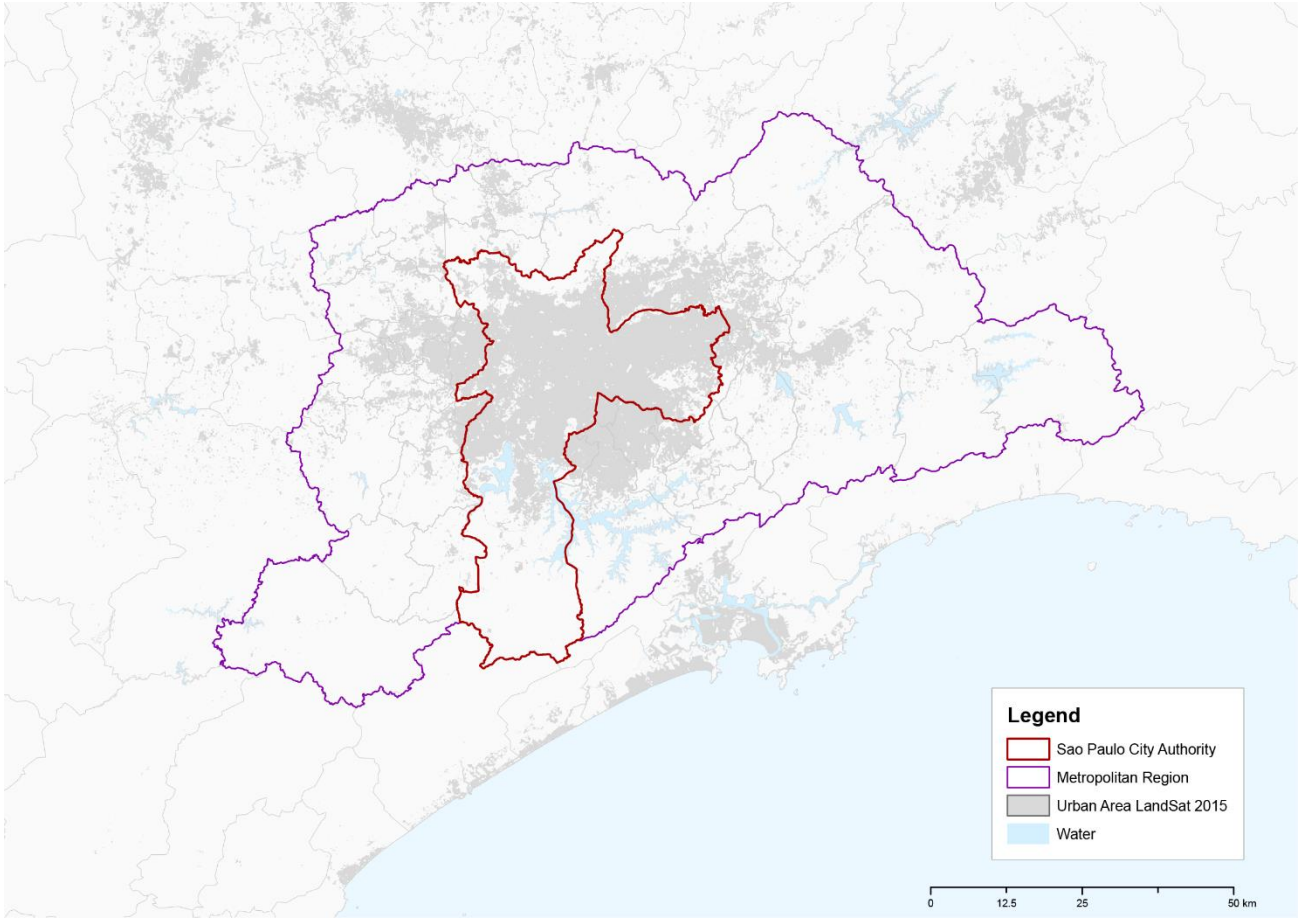


Sao Paulo vs London

- So the very first challenge of the project was to establish whether the two cities were actually comparable, in terms of size, population, and...data!
- The veredict is still not out, but we have made significant headway...
- Let me introduce you to our two case studies: the metropolitan areas of London and São Paulo

Sao Paulo metropolitan area

The metropolitan region of São Paulo is actually an administrative area, so the definition of the area of study was straightforward.

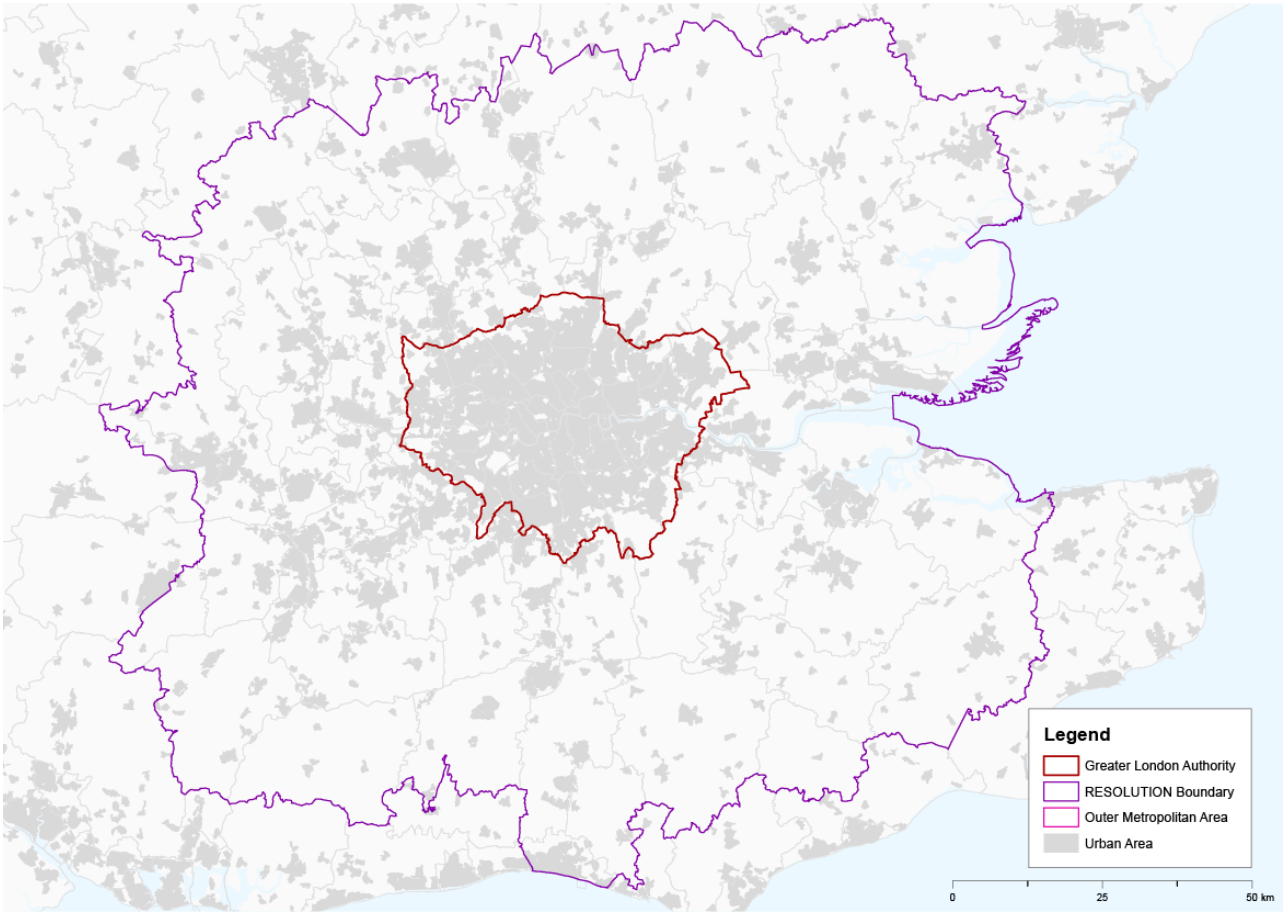


Duncan Smith, CASA UCL, citygeographics.org

London metropolitan area

The metropolitan area for London was a different case as there is no such administrative area.

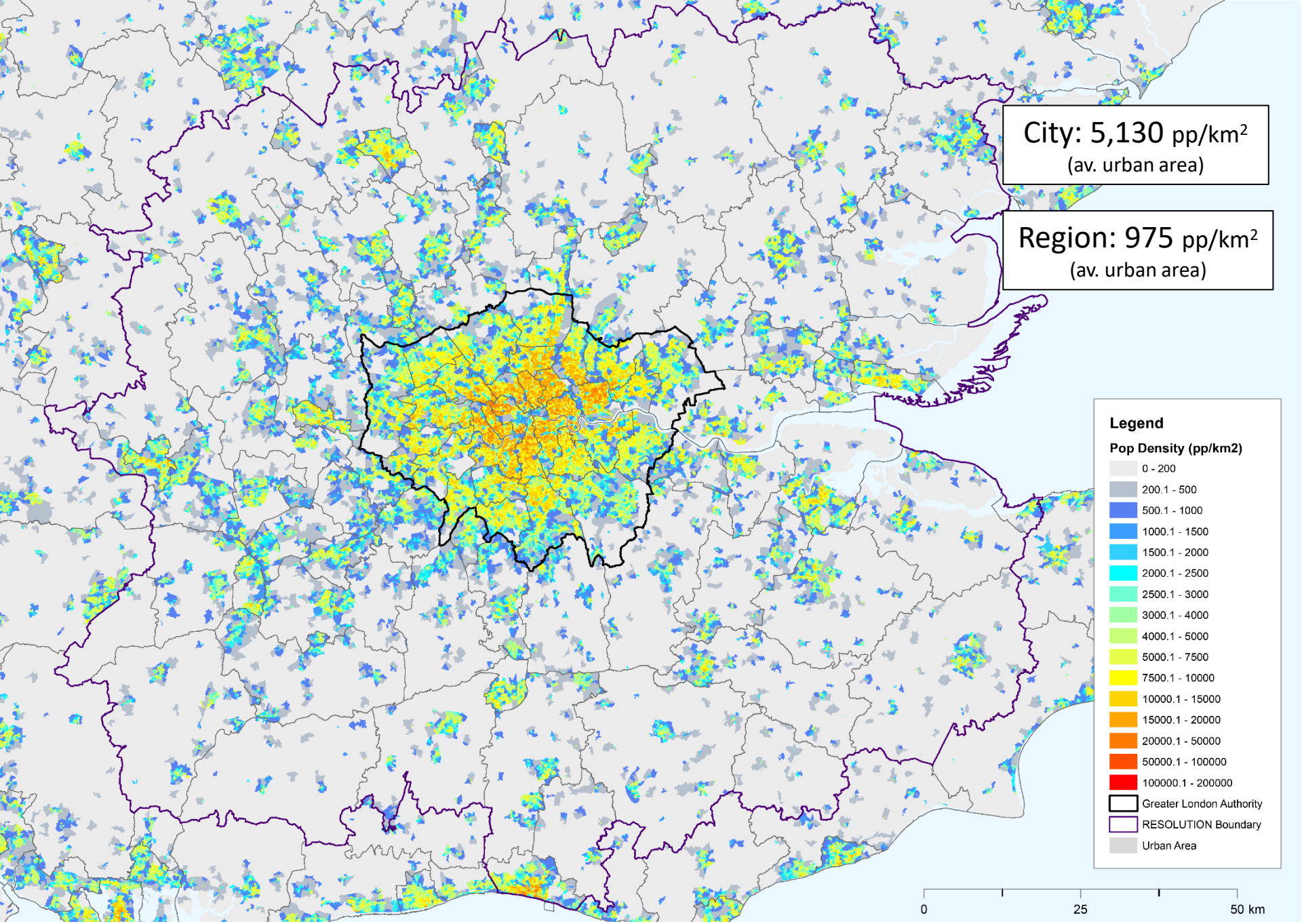
We have defined a metropolitan area for the project by selecting all contiguous local authority areas with a commuting rate of at least 10%.



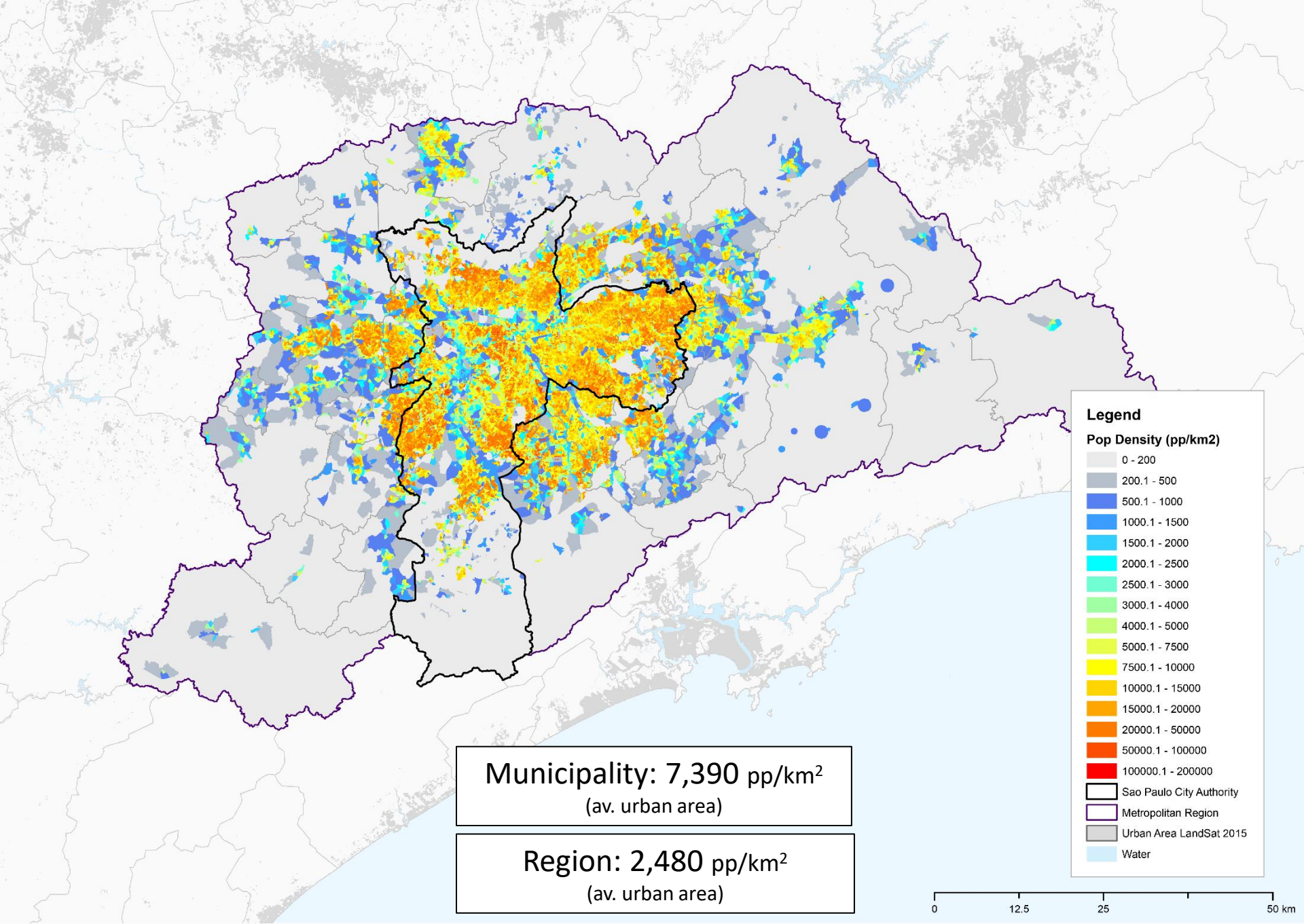
Duncan Smith, CASA UCL, citygeographics.org

Are they comparable?

	Total Population	Total Area (km^2)
São Paulo City Authority	11.3m (2010)	1,523
São Paulo Metropolitan Region	19.7m (2010)	7,944
Greater London Authority	8.2m (2011)	1,594
London Resolution Project Metro. Reg.	15.9m (2011)	16,371



Duncan Smith, CASA UCL, citygeographics.org



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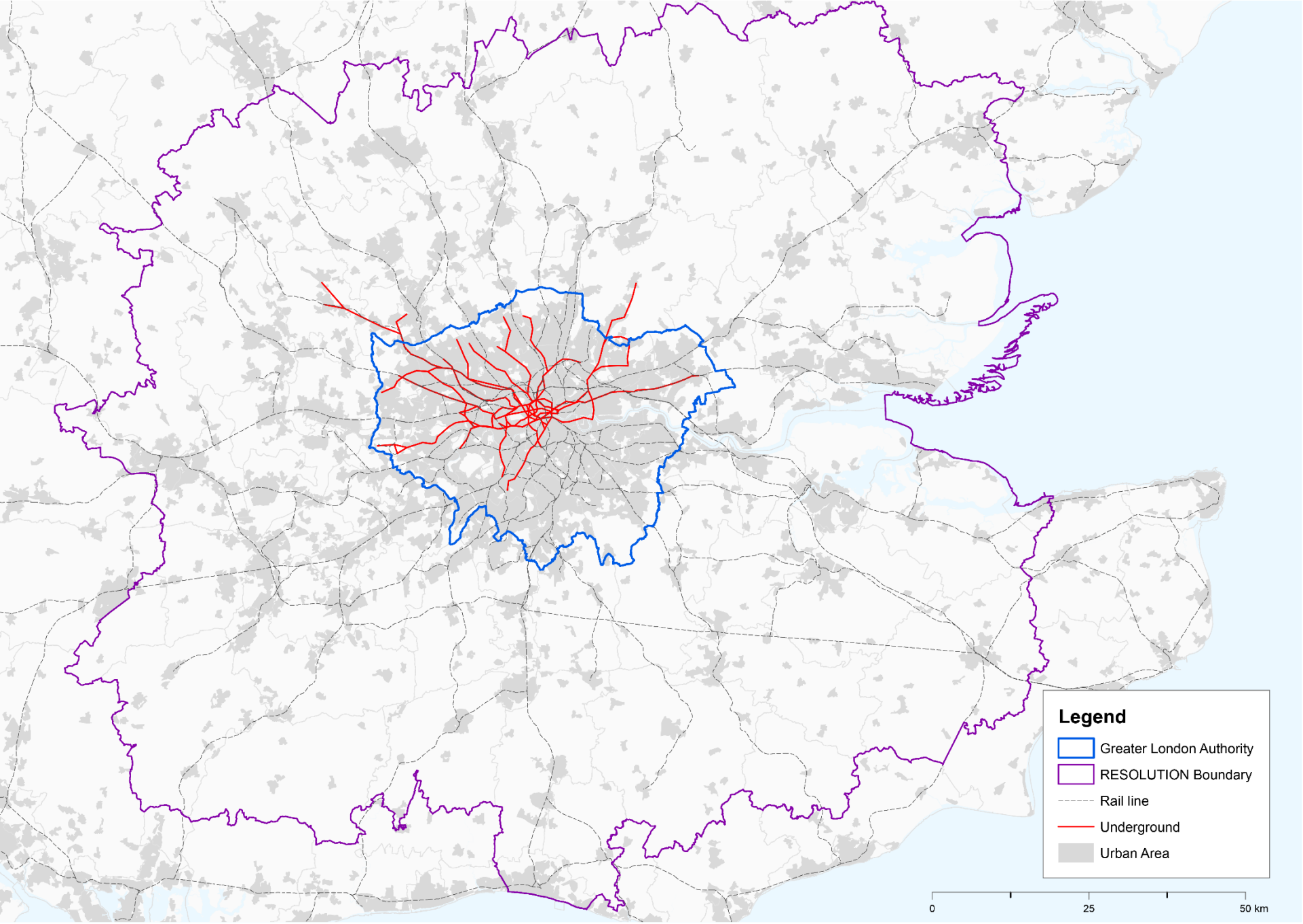

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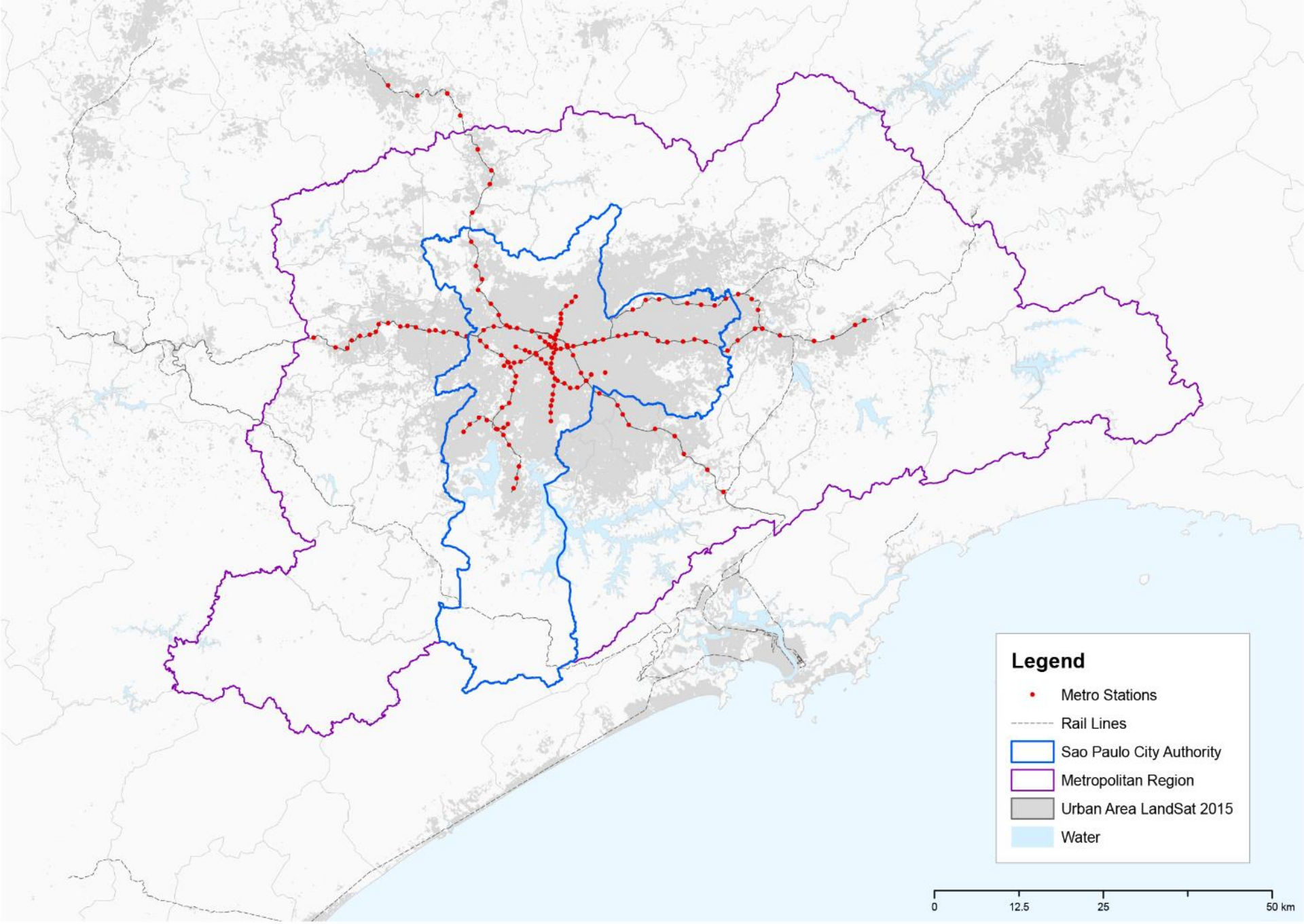


Duncan Smith, CASA UCL, citygeographics.org

Other comparability issues

- An essential part of working with spatial inequality is defining suitable socio-economic groups for analysis
- This is the basis on which segregation metrics work (metrics are based on dissimilarity, diversity, isolation, exposure, etc between different groups)
- There are no established socio-economic groups – rather, there is a whole body of literature discussing socio-economic classes, etc which we would like to avoid!
- Our work has started by defining the variables we were going to work with which are:
  - Income
  - Ethnic groups
  - Qualifications/Education
  - Occupation

Data availability

Variable	Availability UK	Availability Brazil
Income	Averages at MSOA level	Counts census track level
Occupation	Counts at OA and MSOA levels	Counts at weighting area level
Education/qualification	Counts at OA and MSOA levels	Counts at weighting area level
Ethnic groups	Counts at OA and MSOA levels	Counts at census track levels

- A single variable that is available for both countries on higher resolution geography level (OA/CT): Ethnic groups
- Income, which is an important variable for Brazil, does not have equivalent on UK census
- First step was to check the availability for all four variables in the geography levels we had selected to use in the project and check their compatibility
  - Output levels (UK) / census tracks (Brazil)
  - MSOA (UK) / weighting areas (Brazil)

Data comparability

- A small number of groups per category i essential in order to keep analysis manageable
- But finding common groups for both countries was not straighfoward as Census classes from the two countries were often not conceptually equivalent

Ethnic groups

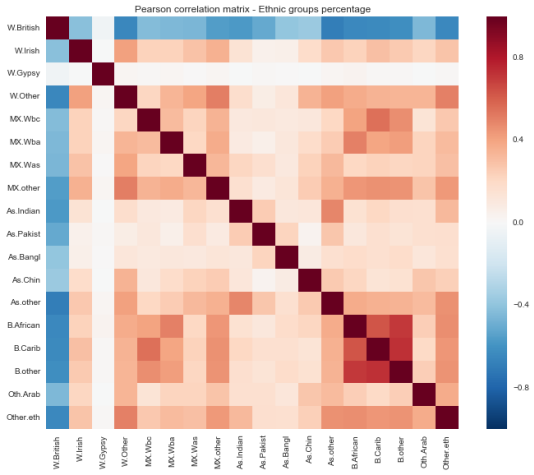
- Clear classes but very different ethnic compositions in the two countries
- Brazil has only 5 classes while UK has 18
- Some classes have clear equivalency, while others are more difficult to match. Ex: where do we place mixed groups?

Race variable - Brazil	
White	White Brancos
Black	Black Pretos
Asian	Asian Amarelos
Black	“Pardos” Mixed black and while
Other	Indigenous

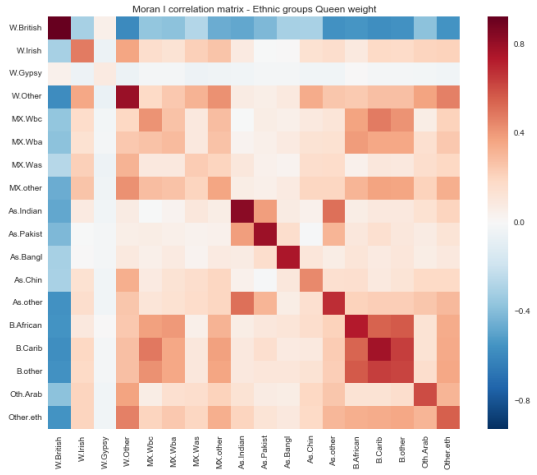
Ethnic groups variable - UK	
White: English/Welsh/Scottish/Northern Irish/British	white
White: Irish	
White: Gypsy or Irish Traveller	
White: Other White	
Mixed/multiple ethnic group: White and Black Caribbean	mixed
Mixed/multiple ethnic group: White and Black African	
Mixed/multiple ethnic group: White and Asian	
Mixed/multiple ethnic group: Other Mixed	
Asian/Asian British: Indian	asian
Asian/Asian British: Pakistani	
Asian/Asian British: Bangladeshi	
Asian/Asian British: Chinese	
Asian/Asian British: Other Asian	
Black/African/Caribbean/Black British: African	black
Black/African/Caribbean/Black British: Caribbean	
Black/African/Caribbean/Black British: Other Black	
Other ethnic group: Arab	other
Other ethnic group: Any other ethnic group	

Ethnic groups

- A methodology was then developed in order to identify groupings combining conceptual analysis and correlation analysis
- Below are examples of the correlation matrices we have used



Pearson's correlation



Moran I – Queen weighting (contiguity)

Ethnic groups

- As the result of the combined conceptual and correlation analysis, the proposed ethnic groupings for London are:

Ethnic groups variable - UK	
White: English/Welsh/Scottish/Northern Irish/British	white
White: Irish	
White: Gypsy or Irish Traveller	
White: Other White	
Mixed/multiple ethnic group: White and Black Caribbean	mixed
Mixed/multiple ethnic group: White and Black African	
Mixed/multiple ethnic group: White and Asian	
Mixed/multiple ethnic group: Other Mixed	
Asian/Asian British: Indian	asian
Asian/Asian British: Pakistani	
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Black/African/Caribbean/Black British: African	black
Black/African/Caribbean/Black British: Caribbean	
Black/African/Caribbean/Black British: Other Black	
Other ethnic group: Arab	other
Other ethnic group: Any other ethnic group	

Ethnic groupings for London	
White British	White British
Other	White Irish White Other Mixed Other Asian Chinese Other Arab Other
Asian	Asian Indian Asian Pakistani Asian Bangladeshi Asian other
Black	Black African Black Caribbean Black other Mixed White Black Caribbean Mixed White Black African
To exclude	White Gypsy

Ethnic groupings for SP	
White	White Brancos
Black	Black Pretos
	“Pardos” Mixed black and while
Asian	Asian Amarelos
Other	Indigenous

Other groupings

- A similar approach was adopted to the definition of groups for the other variables
- Education/Qualification groups were conceptually clearer than ethnic groups while occupational groups were much more complex (and still being defined!)

Education variable – Brazil	
EDU1	No education and incomplete elementary school Sem instrução ou fundamental incompleto
EDU2	Complete elementary school and incomplete high school Fundamental completo e médio incompleto
EDU3	Complete high school and incomplete college Médio completo e superior incompleto
EDU4	Complete College/University Superior Completo
	Not determined Não determinado

Qualification variable – UK	
EDU1	No qualifications
EDU2	Highest level of qualification: Level 1 qualifications
	Highest level of qualification: Level 2 qualifications
	Highest level of qualification: Apprenticeship
EDU3	Highest level of qualification: Level 3 qualifications
	Highest level of qualification: Level 4 qualifications and above
EDU4	Highest level of qualification: Other qualifications

Segregation metrics

- Once groupings were defined, we have started calculating the segregation metrics
  - Local Dissimilarity Index
  - Isolation Index
  - Exposure Index

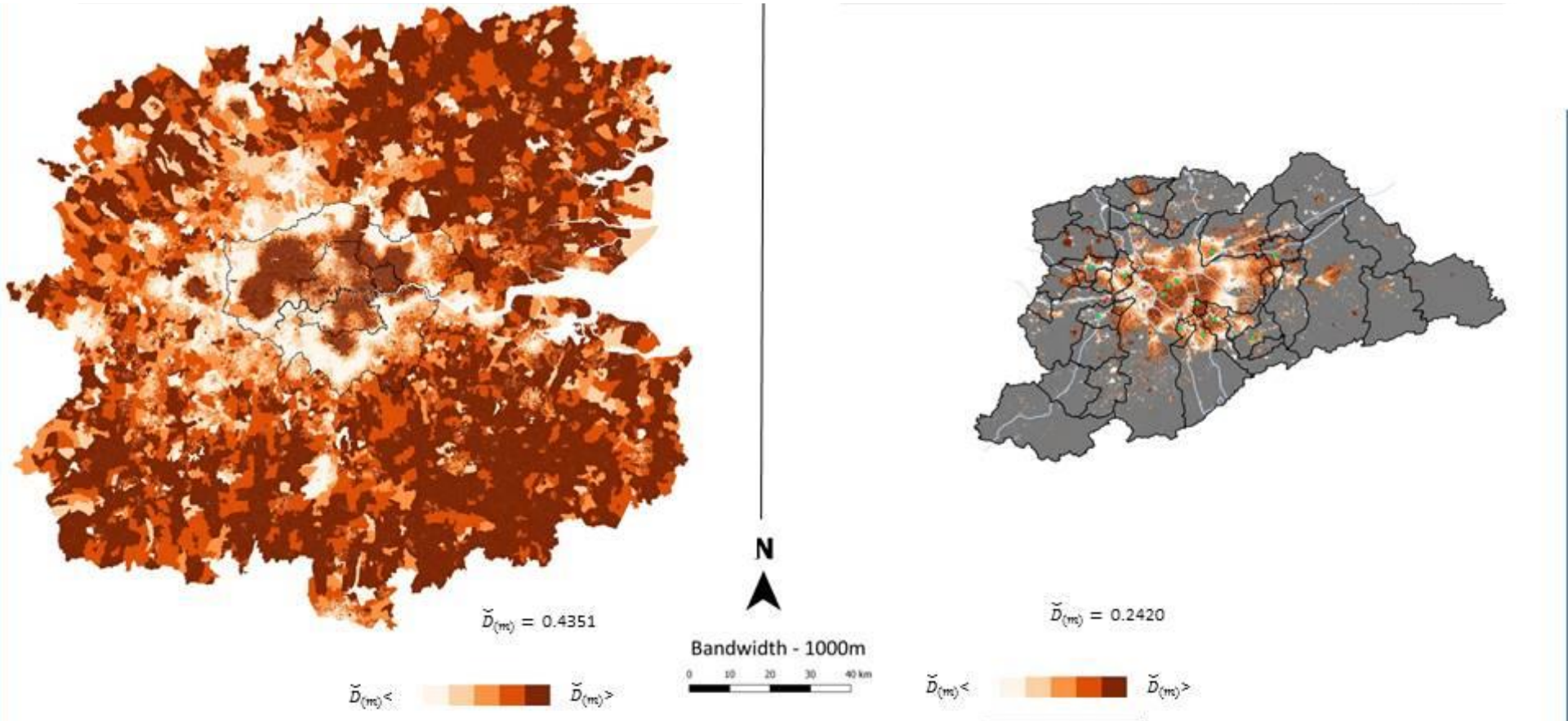
  as developed by Feitosa et al (2007), as well as
  - Entropy Index (Theil 1972; Theil and Finizza, 1971)
- I am not going into the details of those metrics here and instead will show you some of our results which are (hopefully!) more interesting...
- What I will show next is a very small sample of the segregation maps we have produced so far...for ethnic groups alone (coming from 2 census tables!) we have produced more than 300 maps!

Dissimilarity Index

London and São Paulo Metropolitan areas

Ethnic Groups - Dissimilarity Index

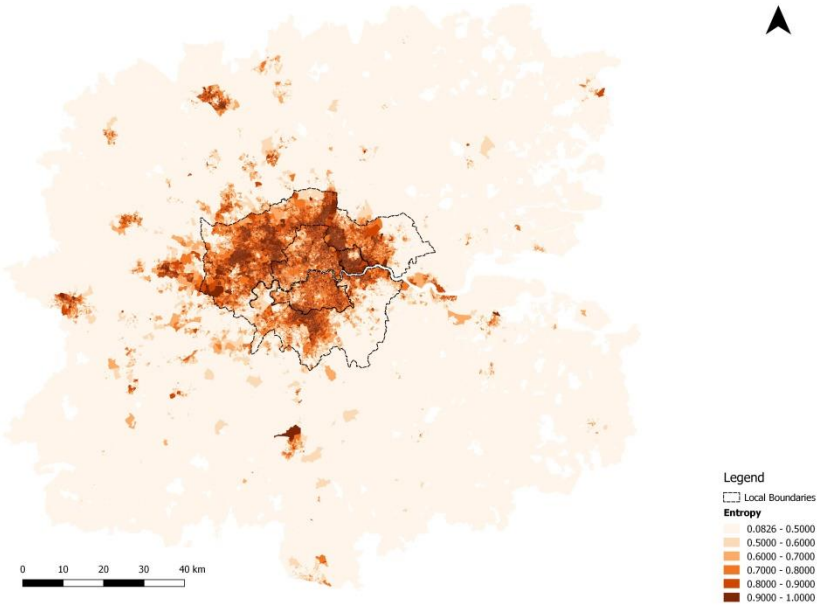
Measures the average difference between the population composition of the localities from the population composition of the urban area as a whole.

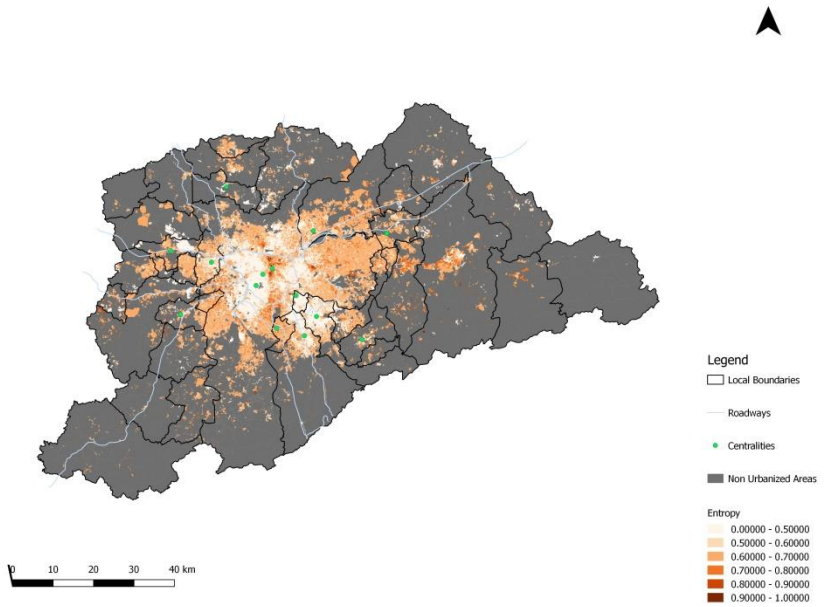


Diversity/Entropy

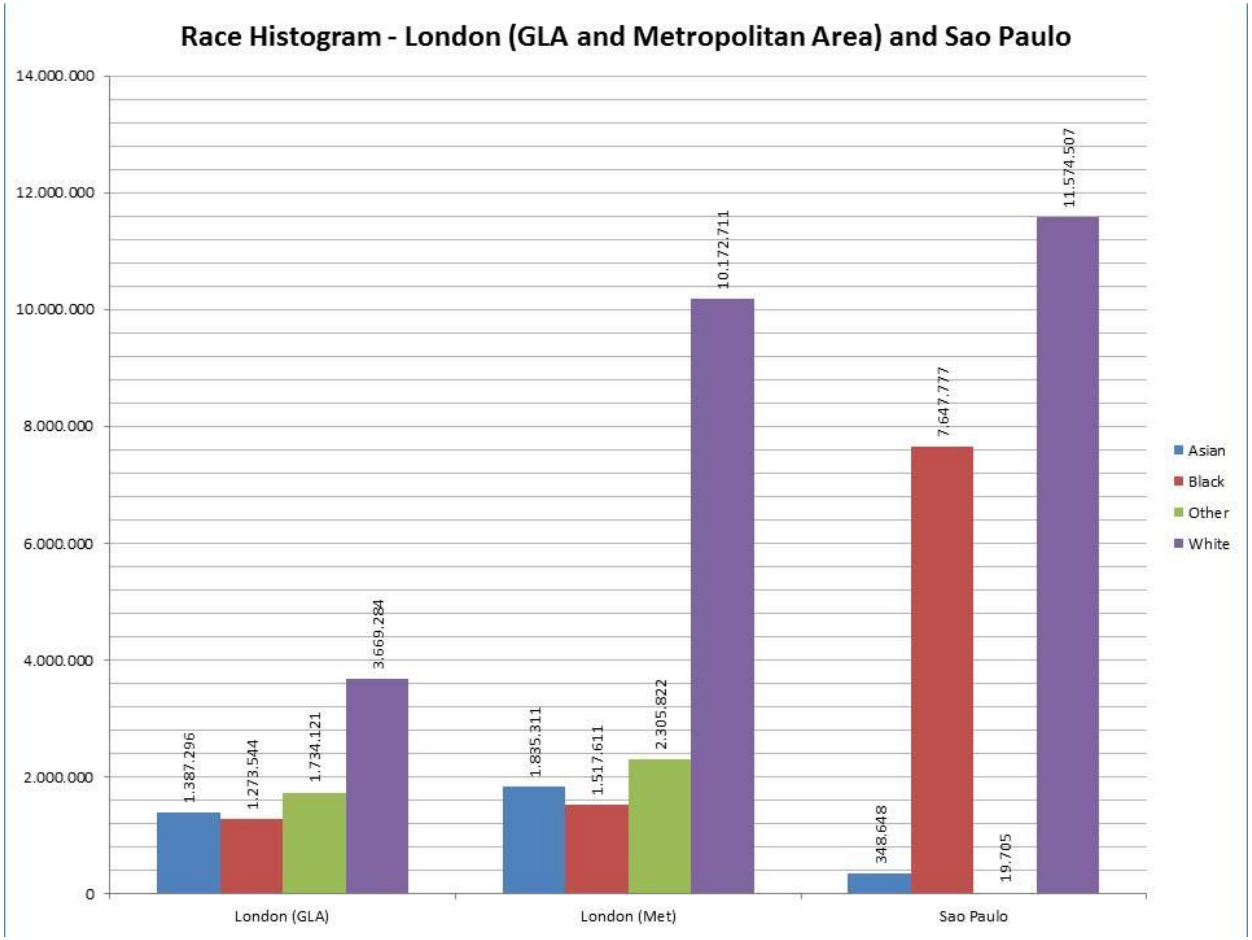
London and São Paulo Metropolitan areas

Ethnic Groups – Entropy Index

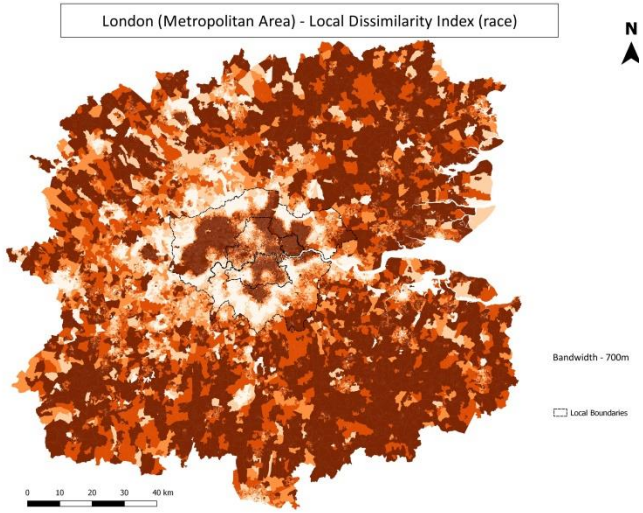


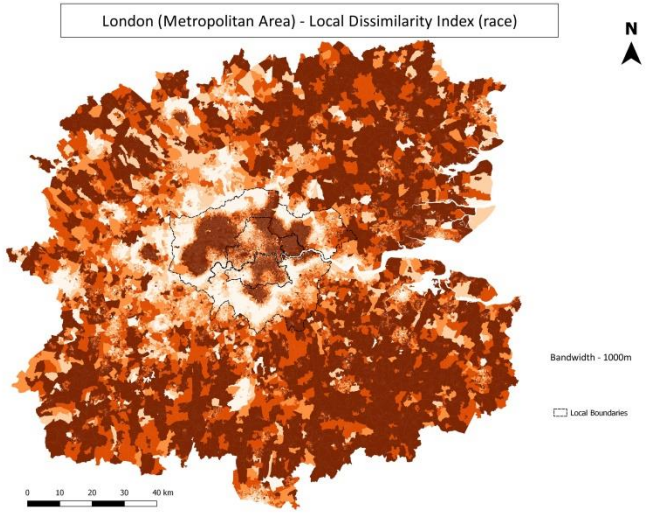


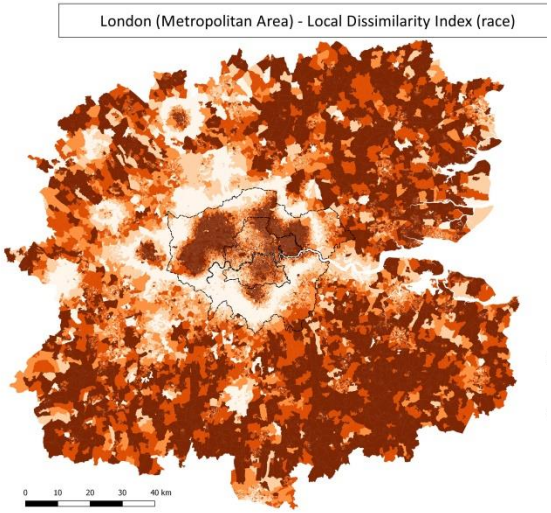
Diversity

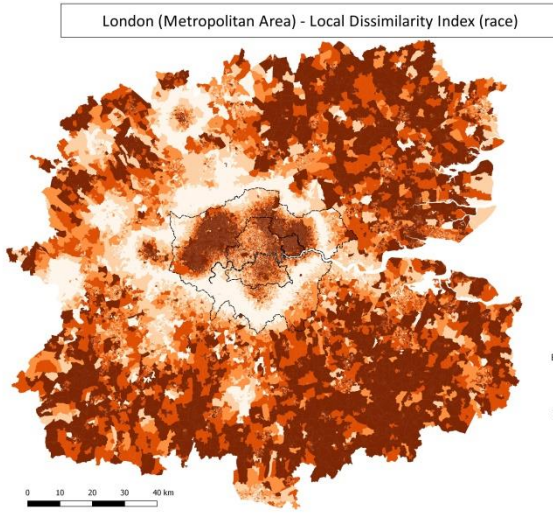

Race Histogram - London (GLA and Metropolitan Area) and Sao Paulo
14.000.000
12.000.000
10.000.000
8.000.000
6.000.000
4.000.000
2.000.000
0
1.387.296
1.273.544
1.734.121
3.669.284
1.835.311
1.517.611
2.305.822
10.172.711
348.648
7.647.777
19.705
11.574.507
London (GLA)
London (Met)
Sao Paulo
Asian
Black
Other
White

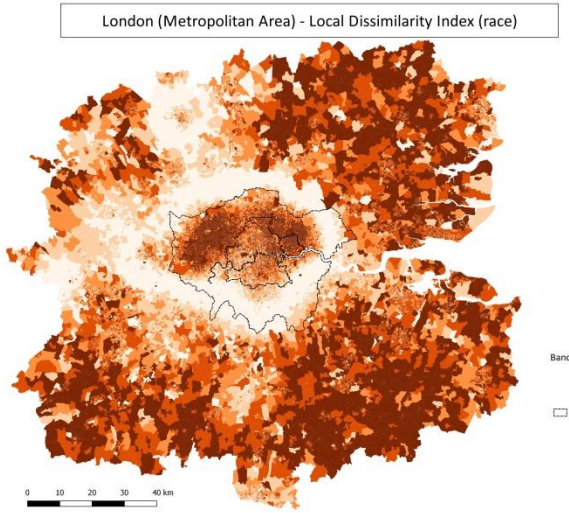
LONDON: Ethnic Groups
Dissimilarity Index across scales



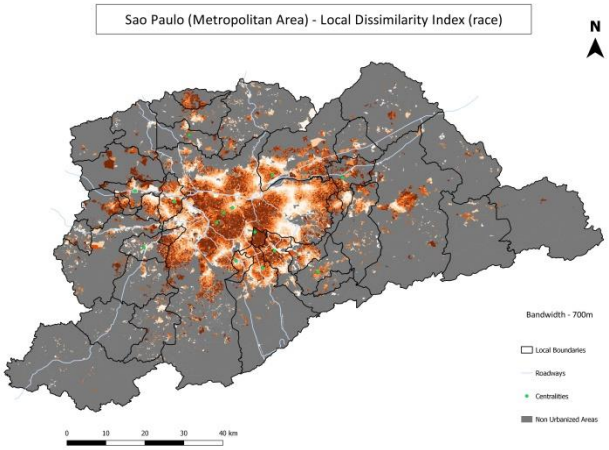


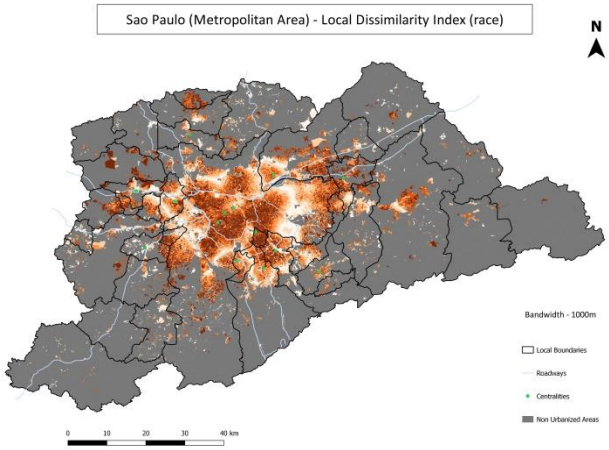


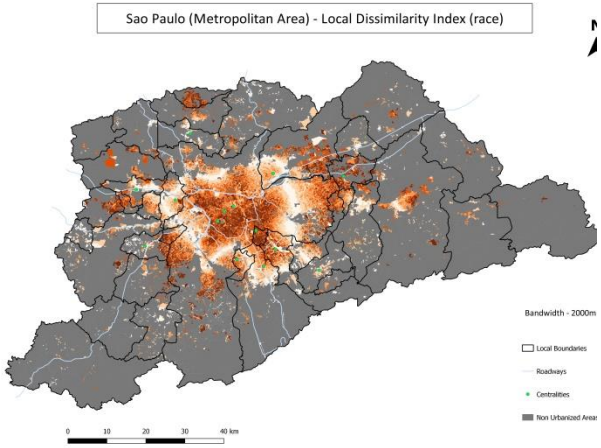


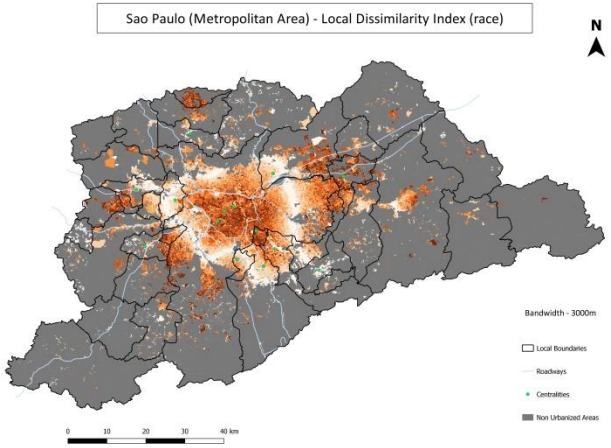


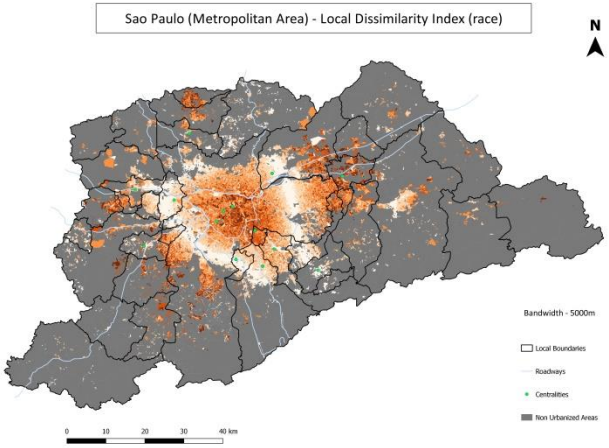
SÃO PAULO: Ethnic Groups Dissimilarity Index across scales



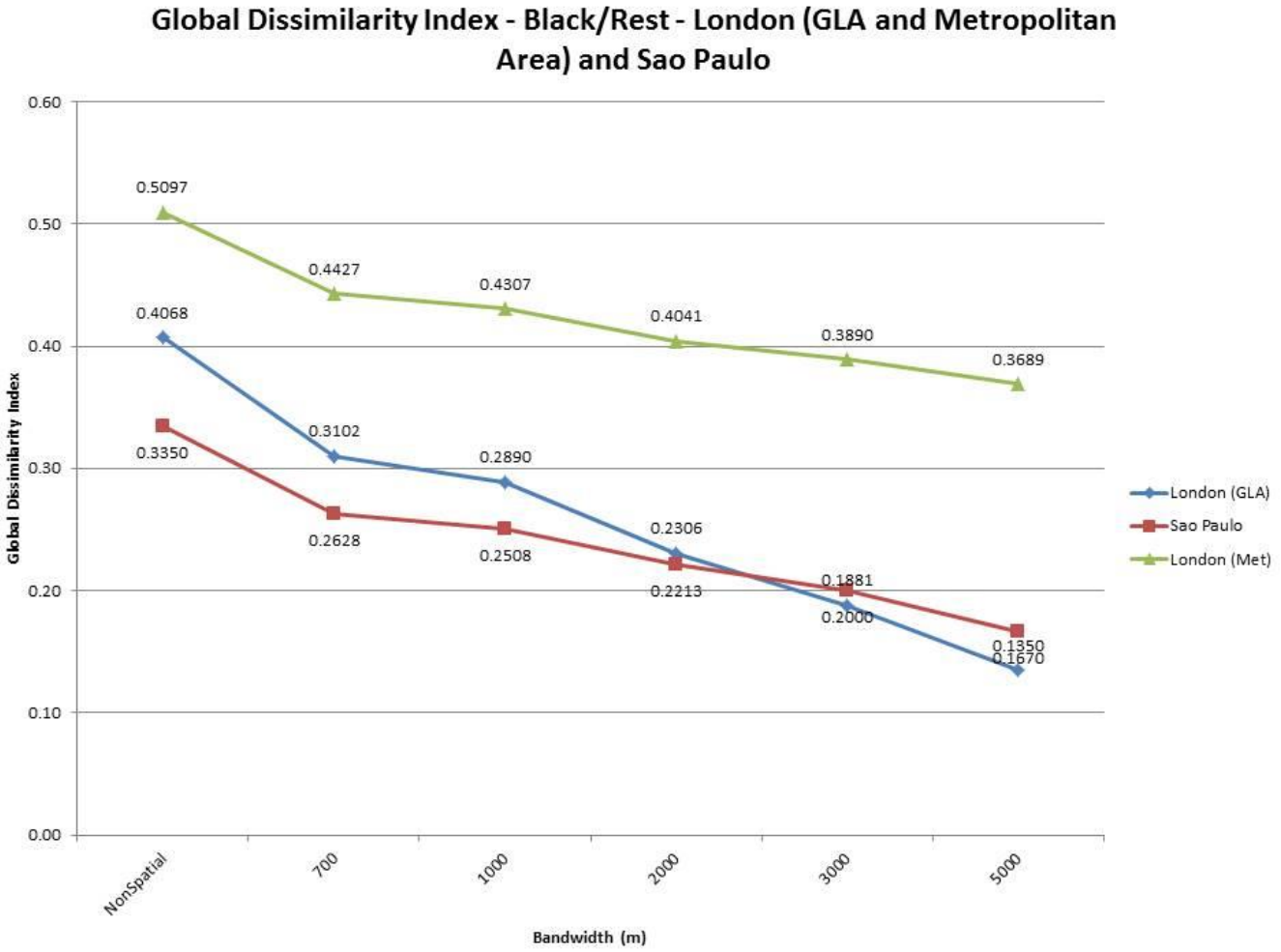








Global Dissimilarity Index across scales

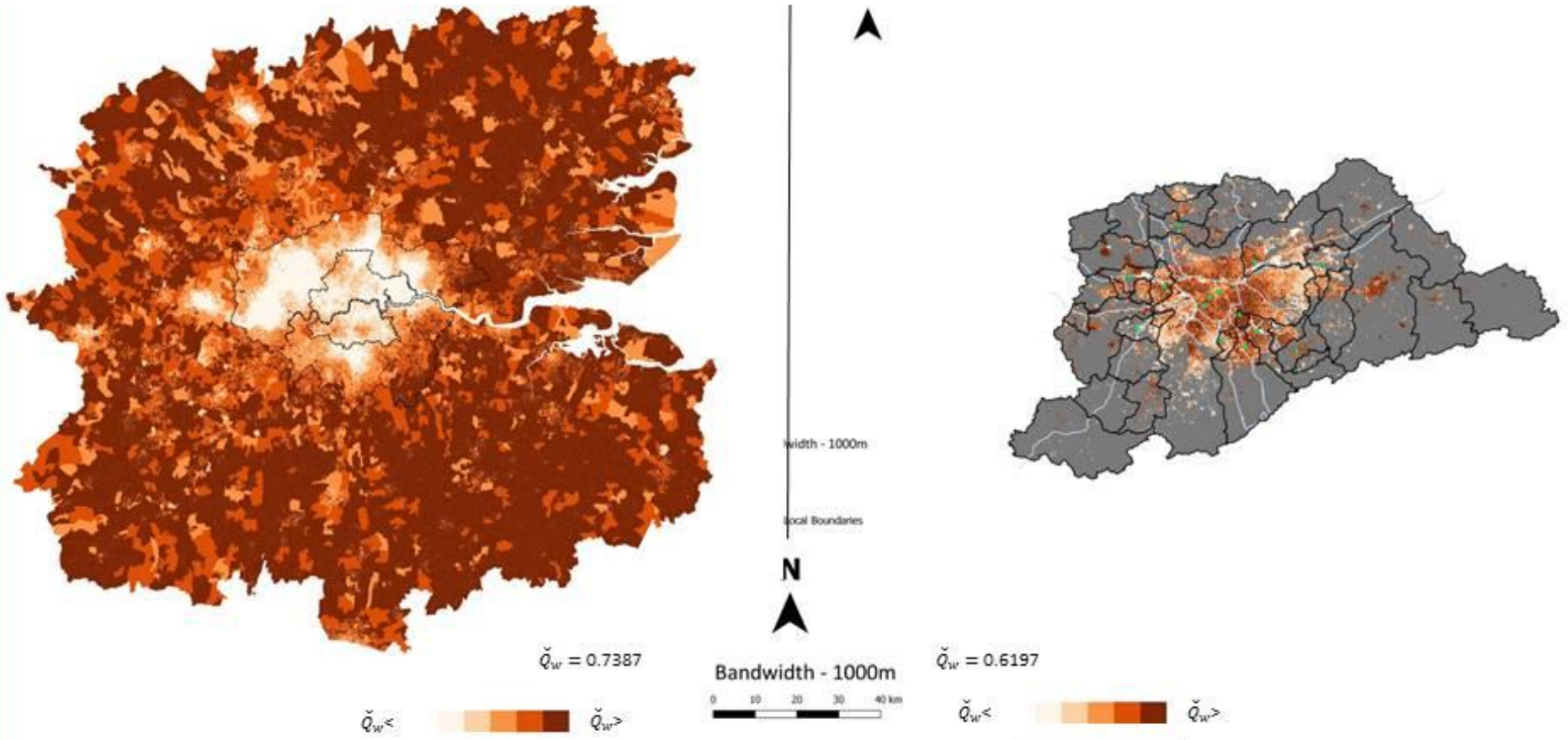


Isolation Index

London and São Paulo Metropolitan areas

Ethnic Groups – White group Isolation Index

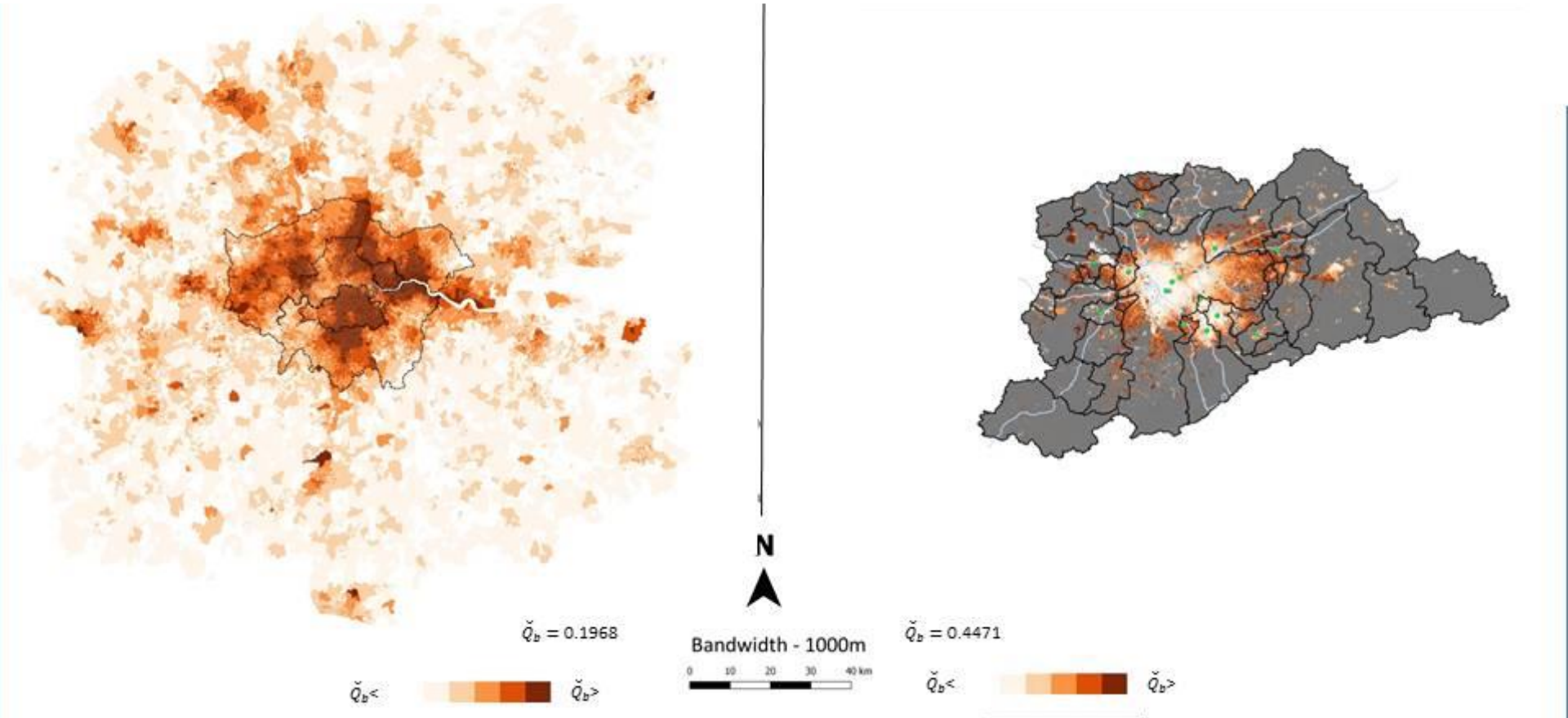
The isolation index is a special case of the exposure index and measures the extent to which a group is exposed to itself.



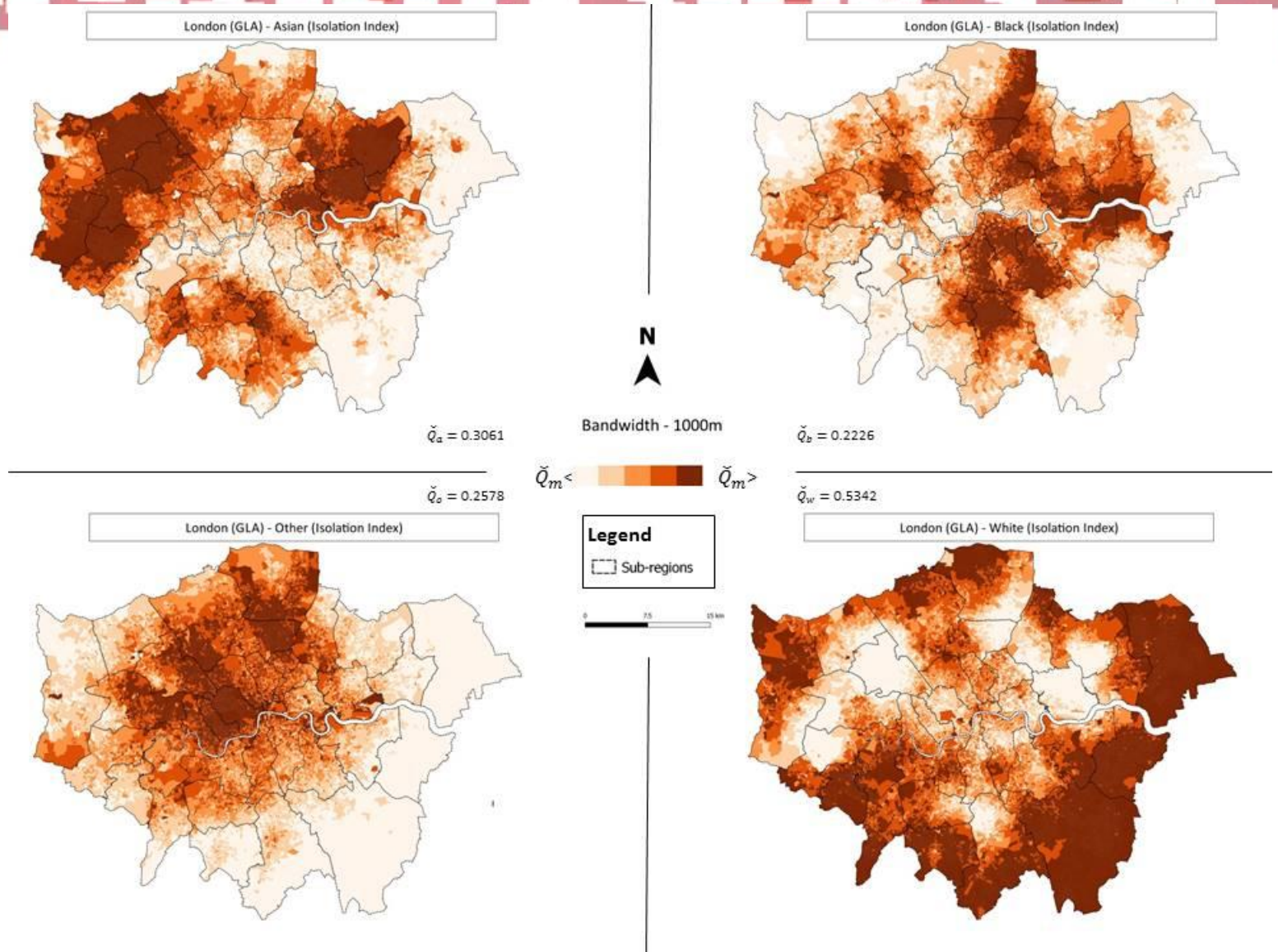
Isolation Index

London and São Paulo Metropolitan areas

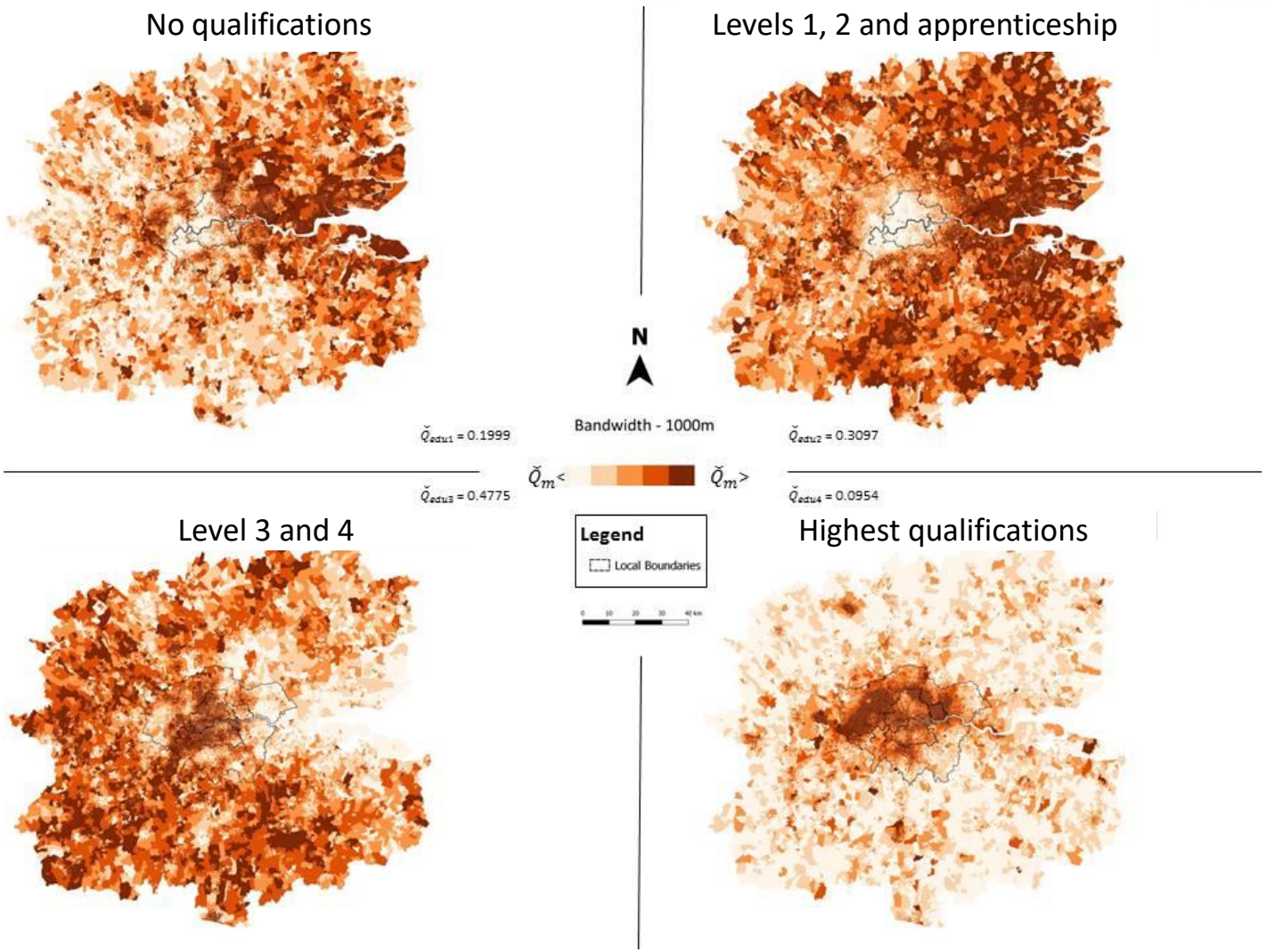
Ethnic Groups – Black group Isolation Index



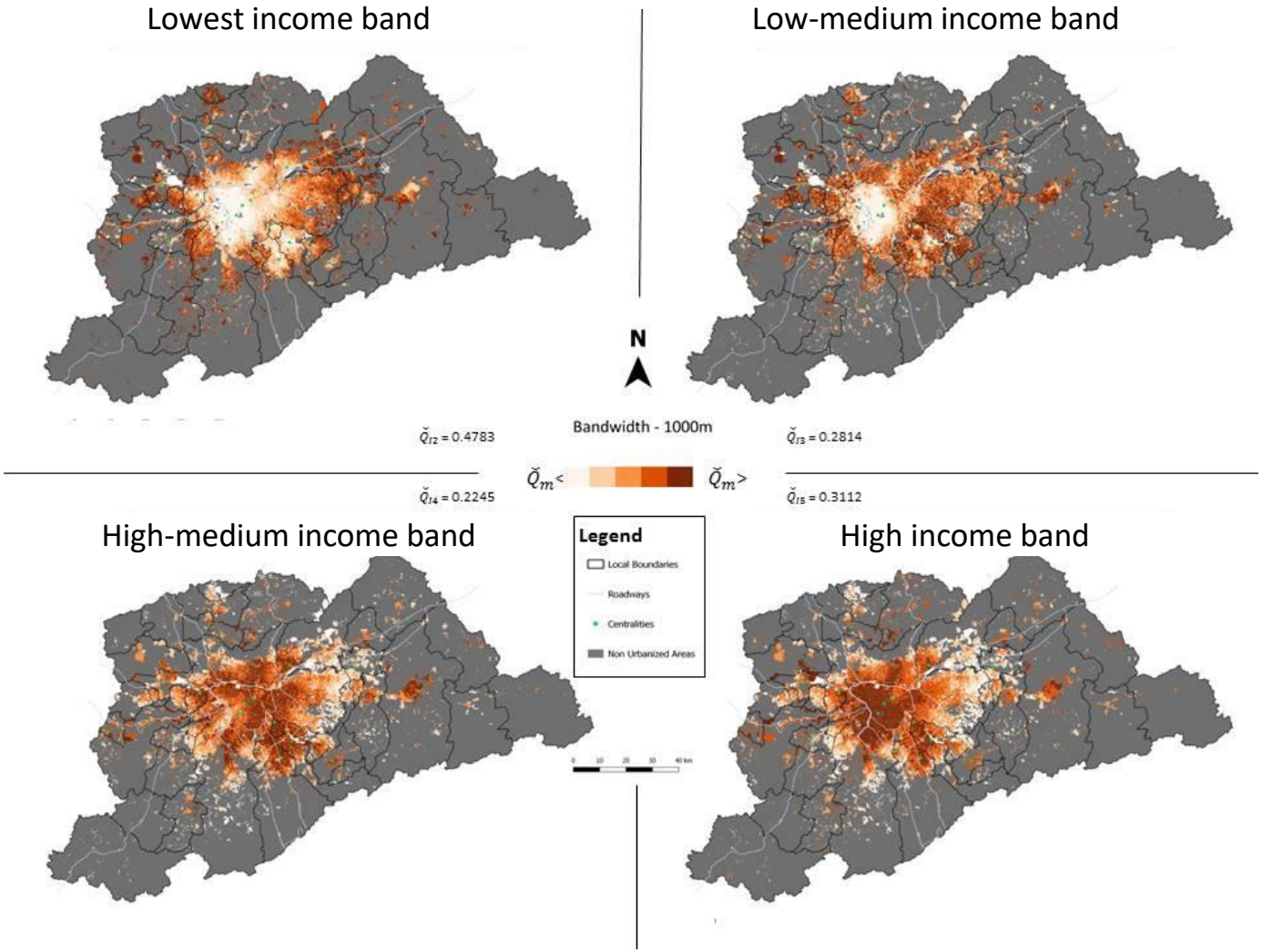
Greater London Authority Area
Ethnic groups: Isolation Index



London Metropolitan Area
Qualifications: Isolation Index



São Paulo Metropolitan Area
Income groups: Isolation Index

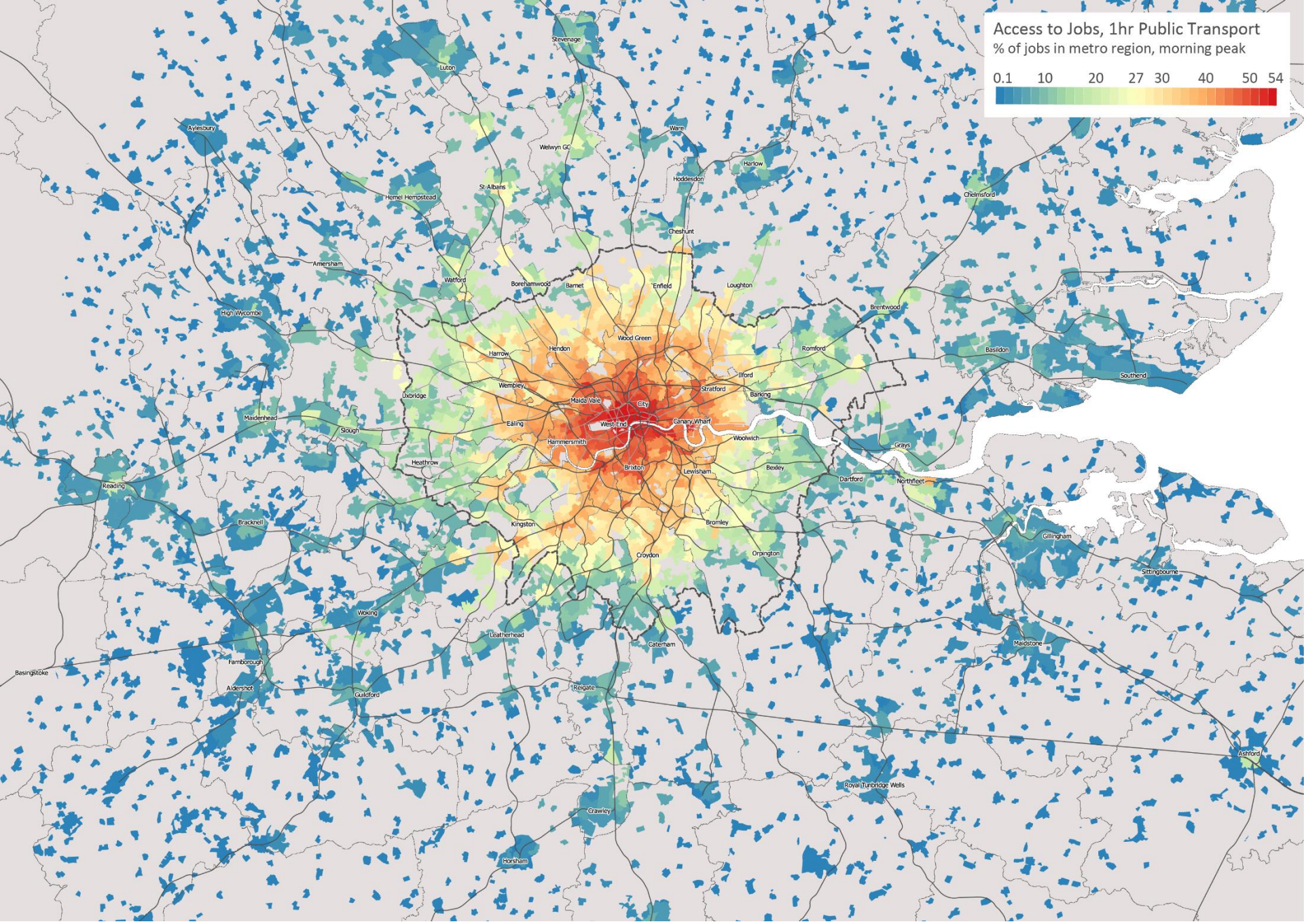


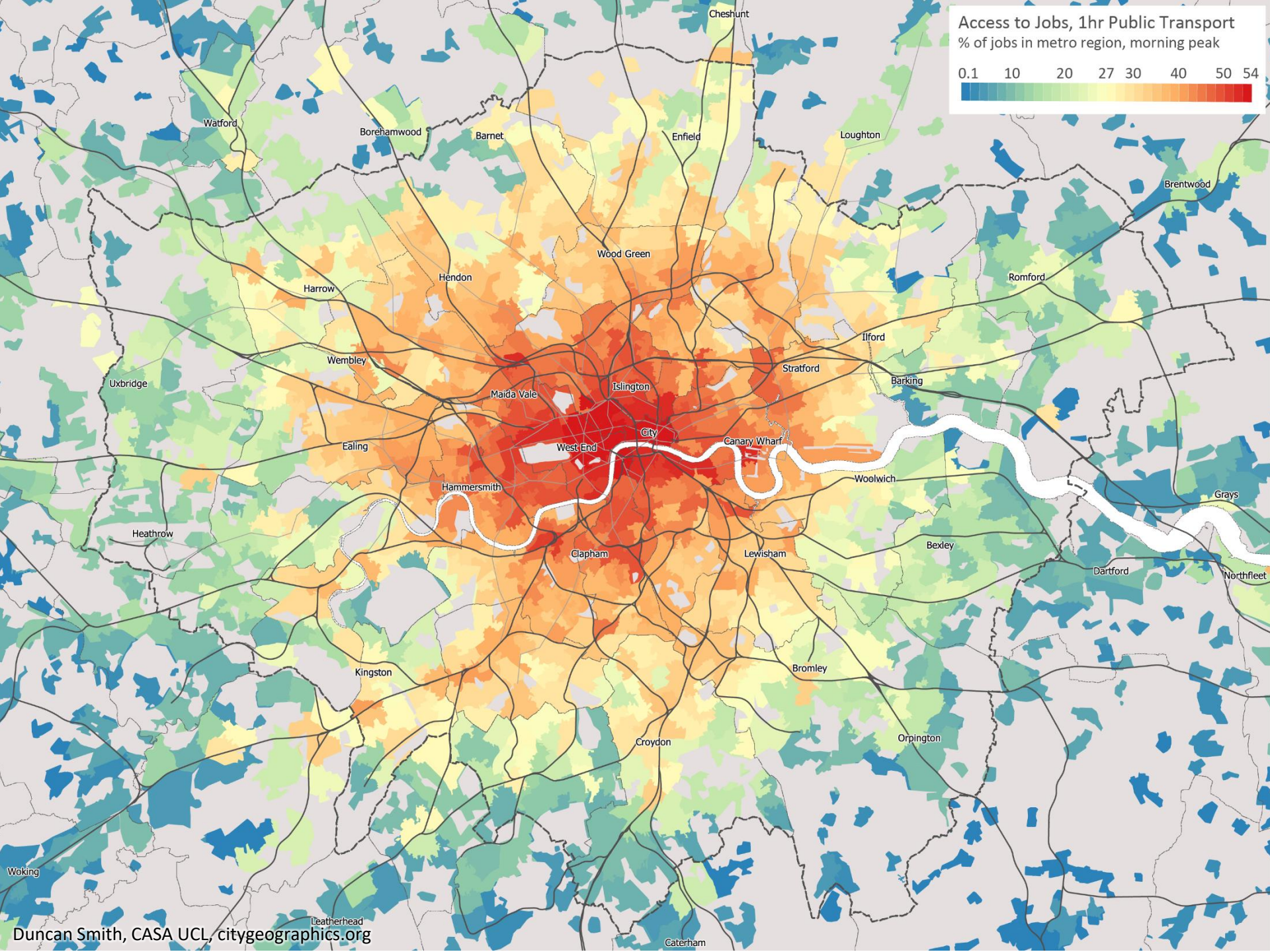
Conclusions on segregation analysis so far...

- Income and ethnic groups segregation follow the same centre-periphery pattern in São Paulo, suggesting strong links between economic and ethnic groups – this comes as no surprise for those who know a bit about the Brazilian socitiety
- In London the segregation patterns are more complex, without clear linkage between socio-economic pattterns and ethnicity
- We hope working with the comparison of educational and occupational groups (which we are finalising this week) will provide a better comparison between the two metropolitan areas. Unfortunately those analysis will have to be developed on a larger resolution scale due to the availability of data for São Paulo.
- São Paulo met area works more like a polycentric (but single) urban area while the metropolitan region of London is better understood as a huge system of cities, towns and villages. This understanding is required to interpret the differences and similarities between those two urban cases.

Accessibility analysis

- We have some results, but methodology and indicators have not yet been finalised.
- Accessibility is being developed by two separate teams: one in Brazil and one in the UK – first face-to-face comparison workshop to happen this week!
- For London, at the moment analysis has been done using public transport access only. Private car accessibility is still in development, with data gathering for generalised cost including parking costs which for London (differently than for SP) are very important for a more meaningful analysis.
- Combination of public transport access and car access important due to trade-offs in inner-city living versus housing costs; resulting in different lifestyles across the London wider region.
- In São Paulo there is a stronger link between mode of transport and socio-economic groups given the lack of quality public transport.


Access to Jobs, 1hr Public Transport
% of jobs in metro region, morning peak
0.1 10 20 27 30 40 50 54
Stevenage
Luton
Aylesbury
Ware
Welwyn GC
Harlow
Hoddesdon
St Albans
Hemel Hempstead
Chelmsford
Cheshunt
Amersham
Watford
Borehamwood
Barnet
Enfield
Loughton
Brentwood
High Wycombe
Wood Green
Harrow
Hendon
Romford
Basildon
Ilford
Southend
Wembley
Stratford
Barking
Uxbridge
Maida Vale
City
Maidenhead
Ealing
West End
Canary Wharf
Slough
Hammersmith
Woolwich
Grays
Heathrow
Brixton
Lewisham
Bexley
Reading
Dartford
Northfleet
Bracknell
Kingston
Bromley
Gillingham
Croydon
Orpington
Sittingbourne
Woking
Leatherhead
Caterham
Maidstone
Farnborough
Basingstoke
Aldershot
Guildford
Reigate
Ashford
Royal Tunbridge Wells
Crawley
Horsham



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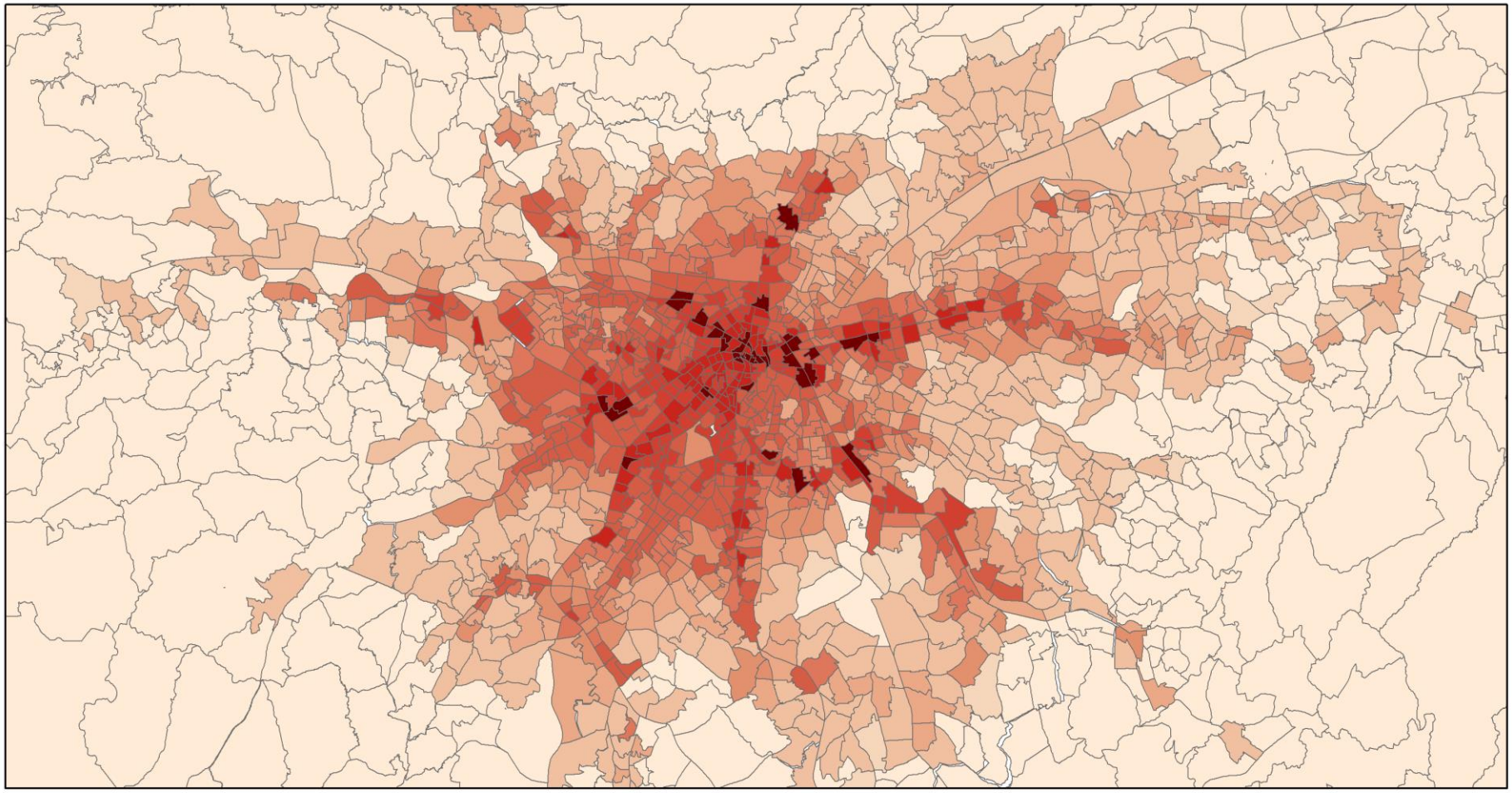


Legend

Accessibility to Jobs 60 Minutes

Values

- 0 - 230588
- 230588 - 250246
- 250246 - 574590
- 574590 - 1012023
- 1012023 - 1494685
- 1494685 - 2005821
- 2005821 - 3014146
- 3014146 - 3512054
- 3512054 - 4123145
- 4123145 - 5090817

N

1:250.000

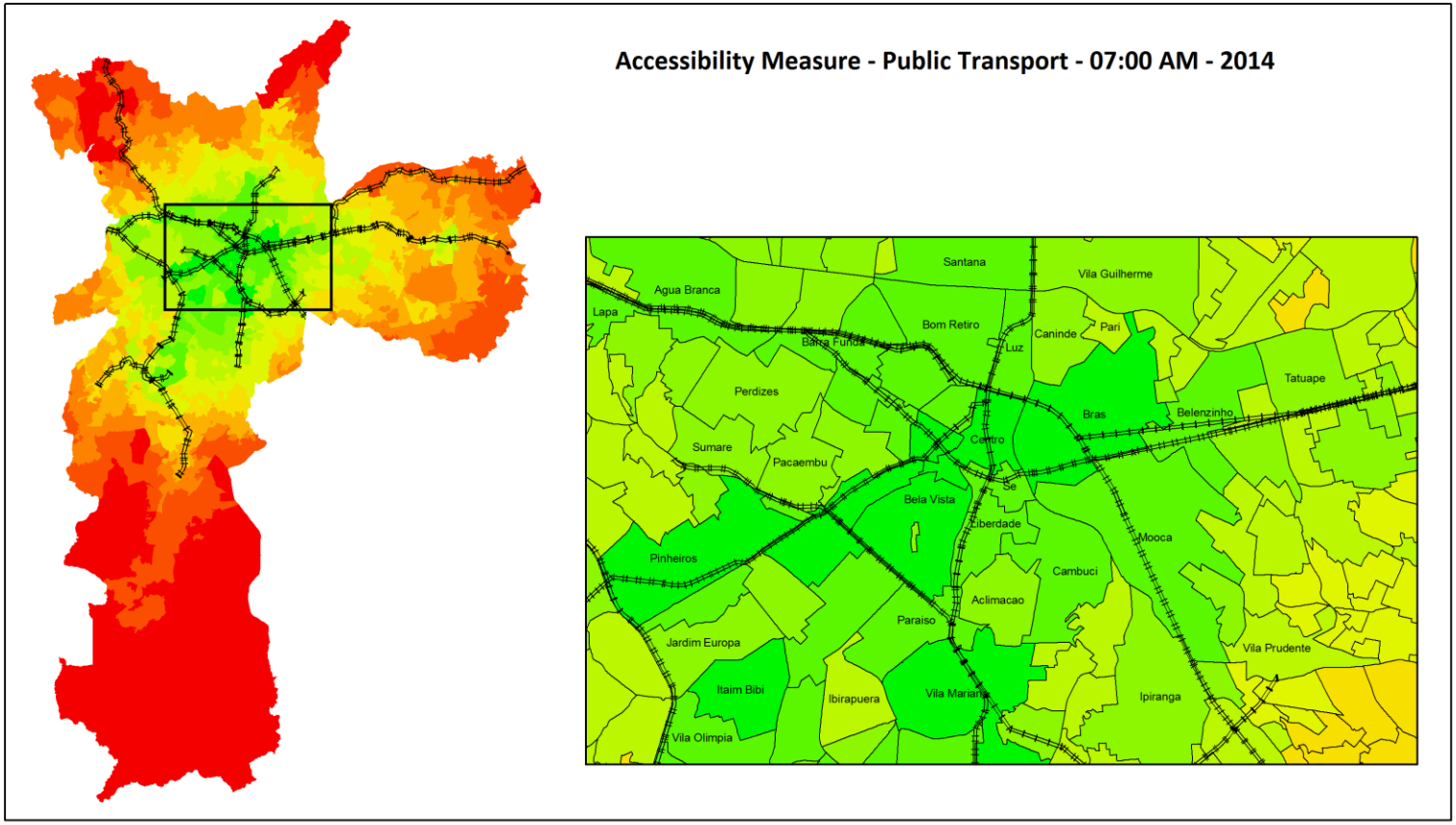
0 1,25 2,5 5 7,5 10

Km

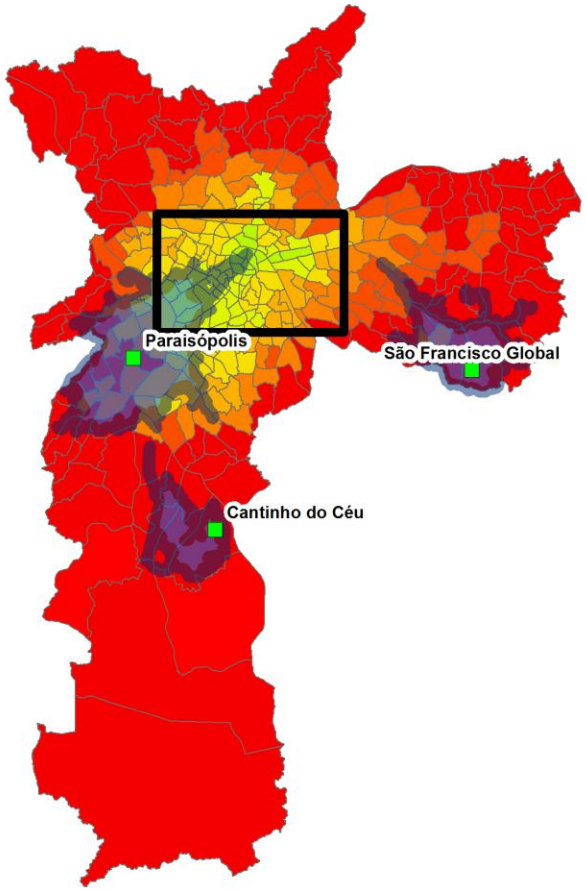
POLI-USP labgeo

Arbex and Giannotti, 2016 (LabGEO)

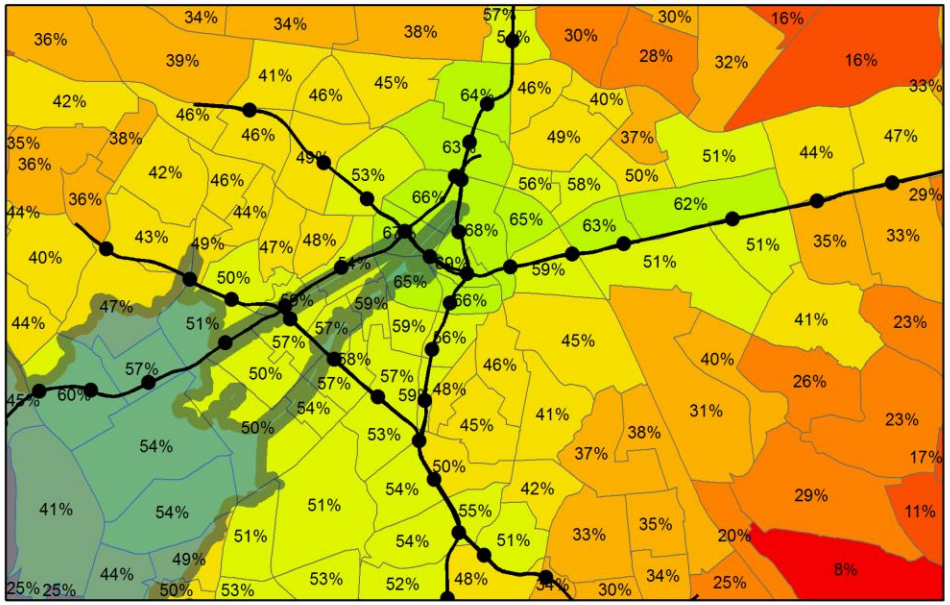
Accessibility public transport



Accessibility São Paulo (municipality)



Percentual of Jobs in 60 Minutes Low Income Areas



Legend

- Subway Station
- Slum
- Subway line
- 1 hour service area

Accessible Jobs per OD Zone

Percentage

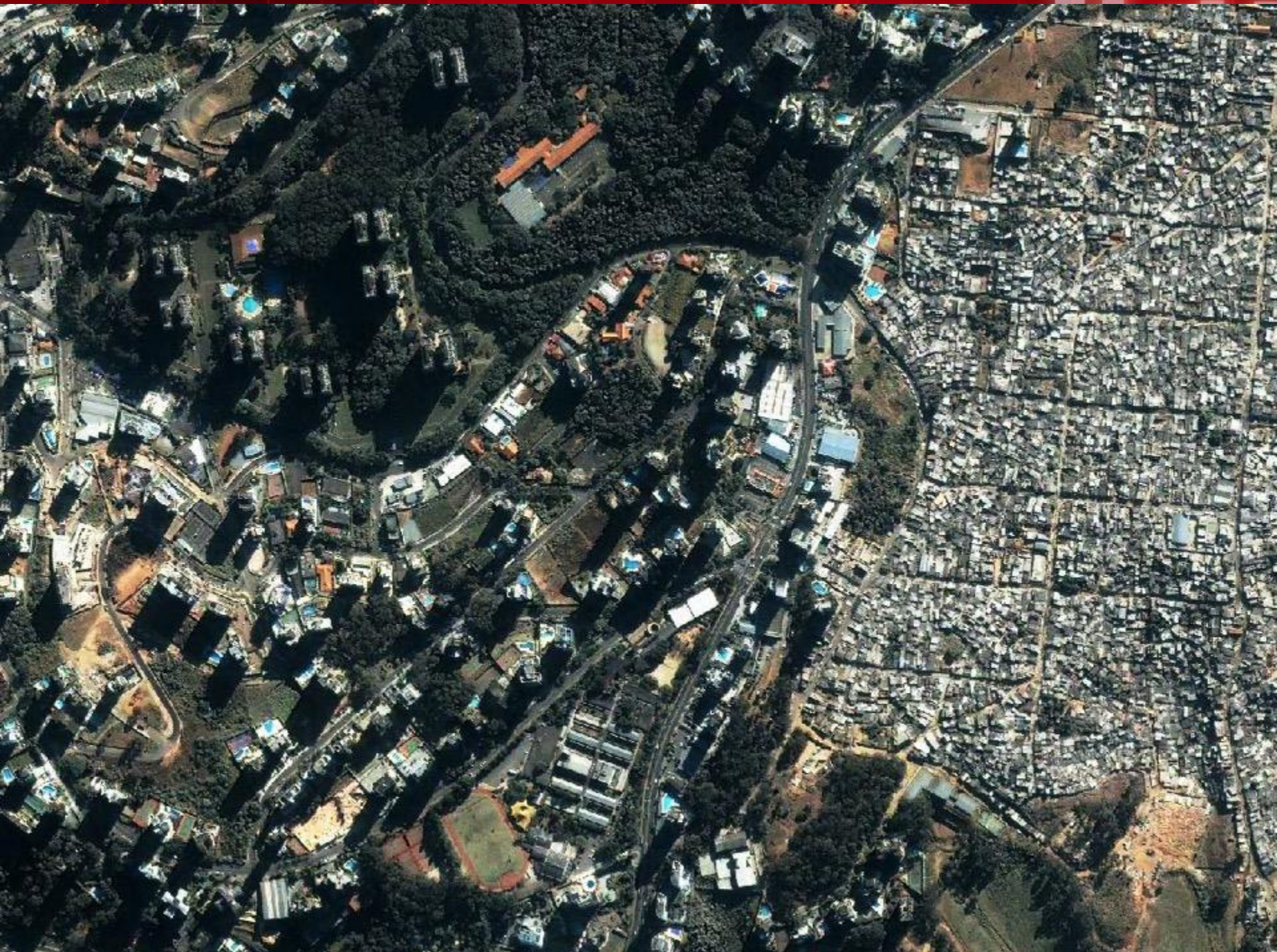
- 0 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70
- 71 - 80
- 81 - 90
- 91 - 100

N

1:100.000

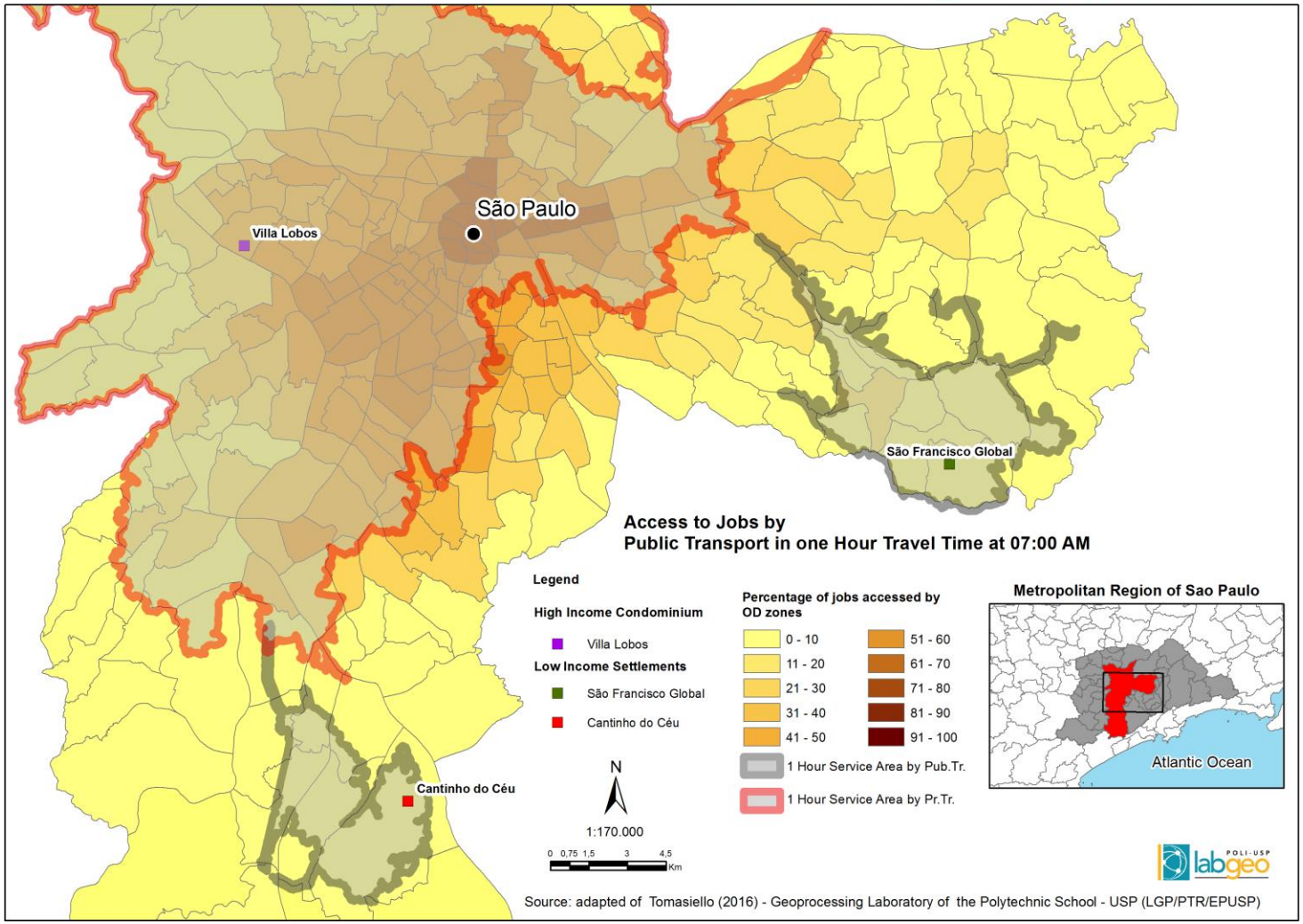
1 0,5 0 1 2 3 4 Km

Tomasiello and Giannotti, 2016 (LabGEO)

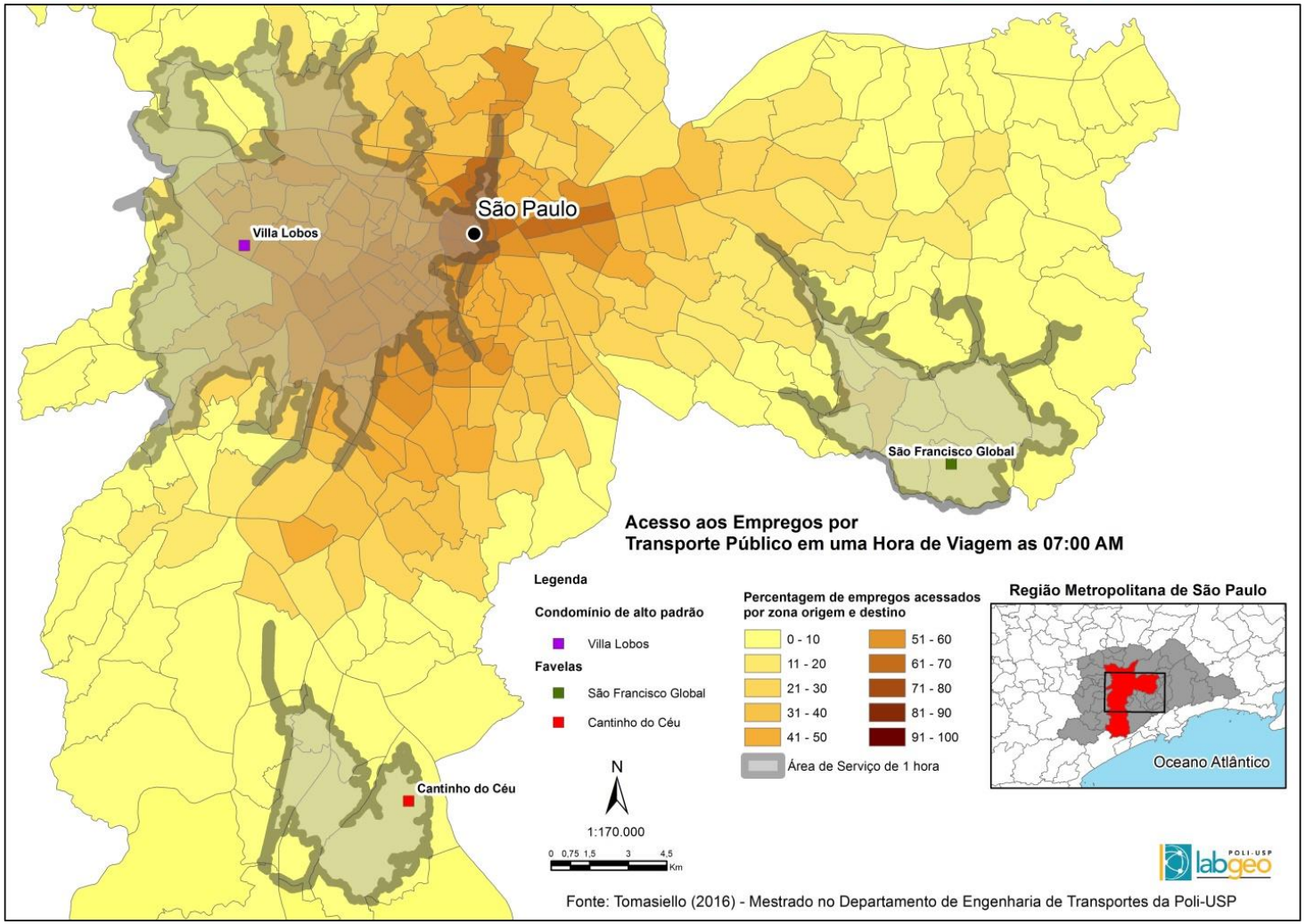


Paraisópolis favela and Morumbi neighbourhood in São Paulo, Brazil. Photo: Tuca Vieira. Source: http://www.bbc.co.uk/schools/gcsebitesize/geography/development/uneven_development_rev3.shtml

Accessibility to who?!



Accessibility to who?!

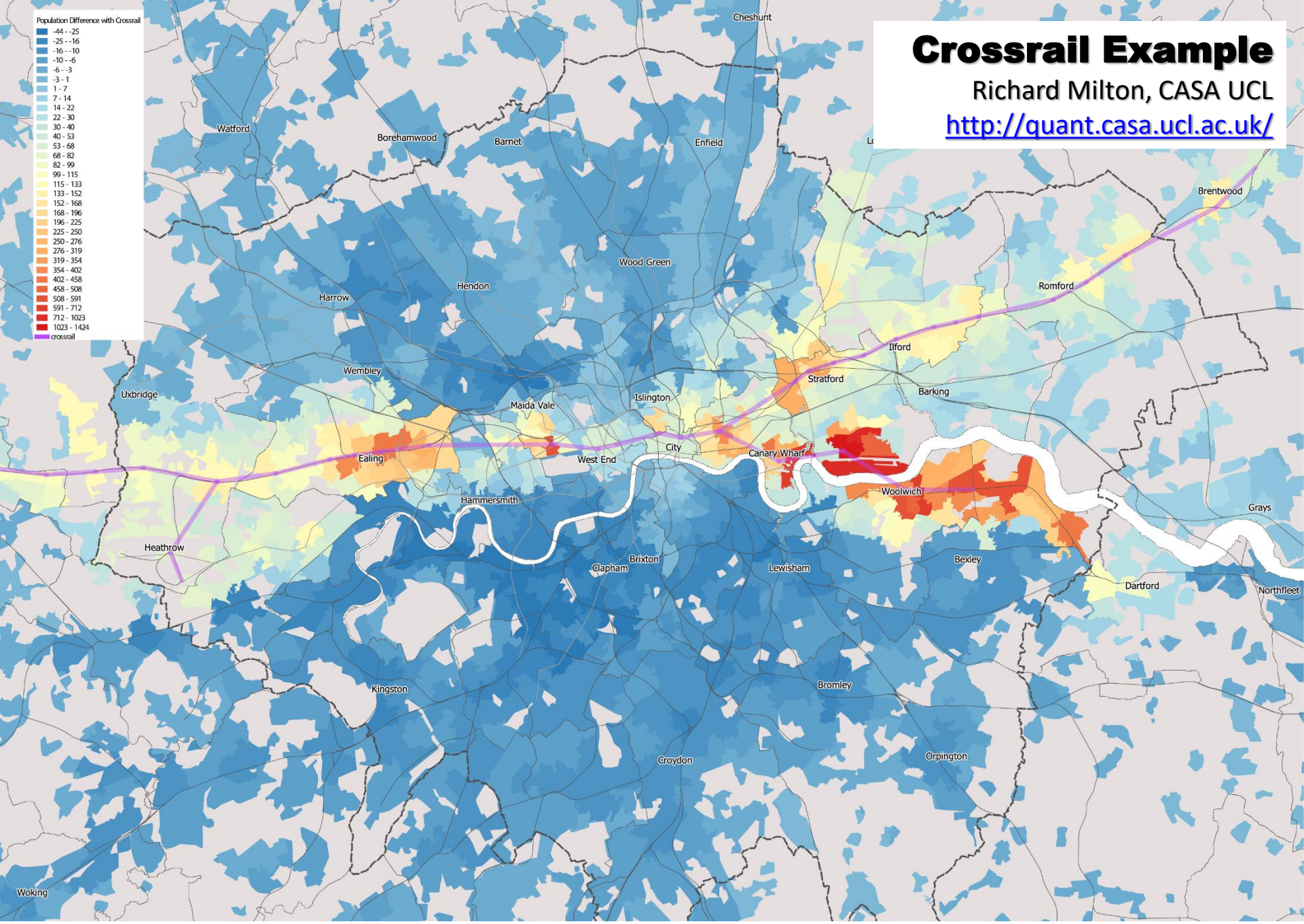


Accessibility to who?

- This is the type of differences we are trying to capture using accessibility and segregation metrics
- We follow the lines of an emerging body of literature looking into underestanding trends of transport justice, equity, and poverty
- We are exploring the concept of 'accessibility poverty' and are currently looking into accessibility metrics disagregated by socio-economic groups
- There is major comparative work still to be done, not only between the two metropolitan areas but also between the patterns of segregation and accessibility

Next steps

- This will be followed by the development of a simple agent-based model which will explore the relationship between spatial inequalities /segregation and acessibility (not only jobs but health, education, etc) via transport.
- Both the model and the metrics will allow us to evaluate the impact of transport projects and policies through what if scenarios
- For existing projects, such as crossrail in the UK we will be able to measure its social impact in terms of accessibility
- The model will also allow us to look into different scenarios and hopefully will serve as a tool to think about new projects and policies.
- Finally, all results will be made available through the online portal for general public and stakeholders



Crossrail Example

Richard Milton, CASA UCL
http://quant.casa.ucl.ac.uk/

- Last, but not least, I would like to highlight the contribution we hope to make for comparative studies
- We hope is this study provides a methodological framework for comparative studies of segregation – not only across the Global South and North but also for comparative studies elsewhere, such Europe (where data comparability should be easier)
- When attempting to develop a better understanding on urban systems - and in particular issues concerning spatial inequalities – we believe it is only by looking into different cities and attempting to apply the same methodologies and comparing results that theories can be truly tested and developed.
- At the heart of this idea is a belief that cities across the globe are similar in nature and present different manifestations of similar dynamic processes.

Thank you!

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http://www.urbantransformations.ox.ac.uk/project/resolution-resilient-systems-for-land-use-transportation/