INSTITUTO NACIONAL DE ESTATÍSTICA
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Clustering mobility

combining geospatial and statistical data to define metropolitan subareas for the IMOB Survey sampling design

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Overview

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3 | Selection of input indicators

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BACKGROUND

Instituto Nacional de Estatística
Statistics Portugal

Statistics Portugal recently conducted a Mobility Survey

imob
INQUÉRITO À MOBILIDADE
Conhecer para melhorar. Vamos mover esta ideia.

AIM | obtaining detailed information on mobility characteristics and patterns of the population living in the metropolitan areas of Lisbon and Porto

INNOVATIVE APPROACH

- Territorial division for sampling design → **defining homogenous mobility areas**
- Data collection modes → combining computer assisted WEB interview (CAWI) and computer assisted personal interview (CAPI)
- Use of Google API (maps) to collect mobility trajectories – origins and destinations

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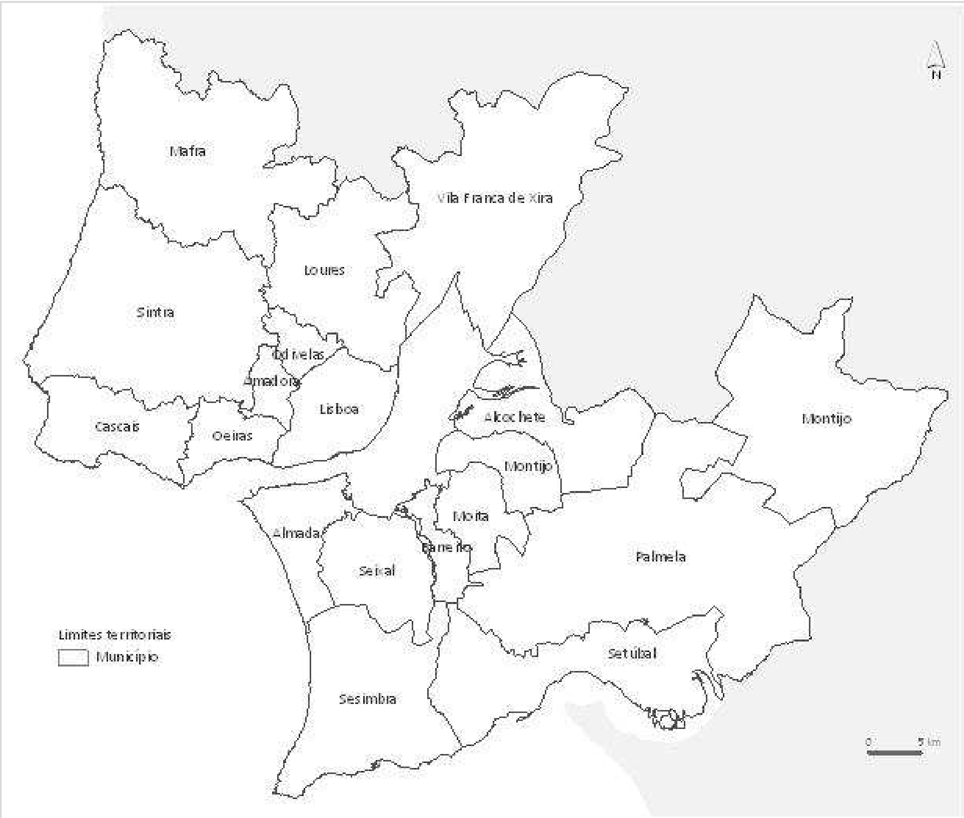
Territorial Scope

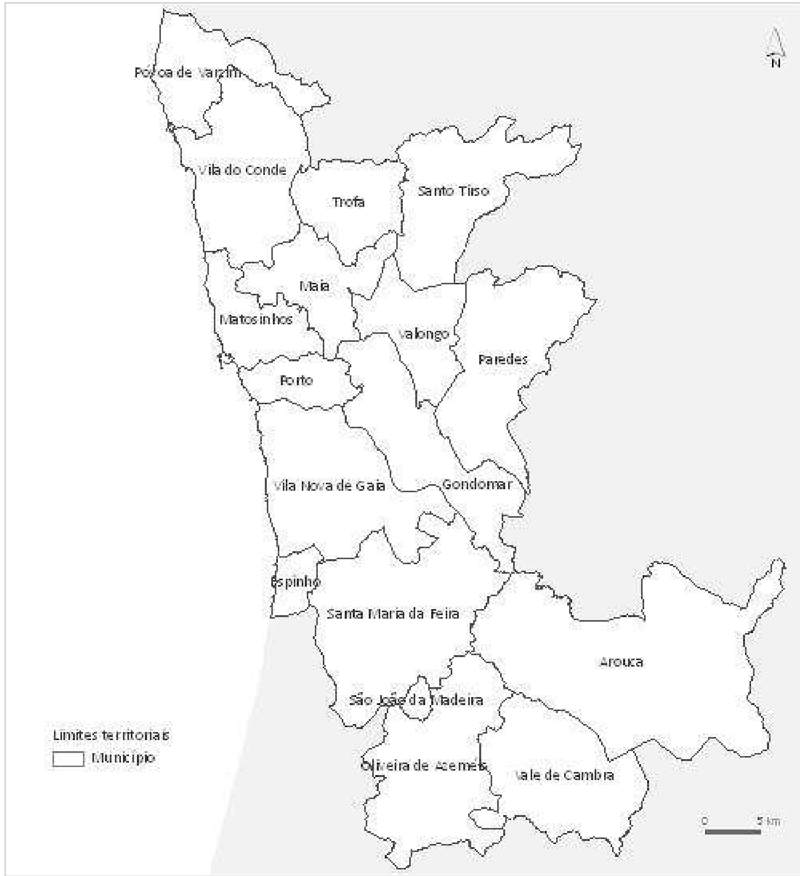


Lisbon Metropolitan Area

18 municipalities (LAU 1)
118 parishes (LAU 2)

Porto Metropolitan Area

17 municipalities (LAU 1)
173 parishes (LAU 2)



AIM

Definition of metropolitan areas with similar mobility characteristics below the municipality level based on objective statistical indicators to be considered in the IMOB survey sampling design

Highlight the potential of combining geospatial and statistical data to derive relevant indicators to better capture territory-based dimensions – mobility and access to transports

Selection of Input Indicators

Calculation of a set of relevant indicators on the share of population served by transport mode at parish level

Twofold perspective

Selection of a set complementary 2011 Census commuting indicators at parish level

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POPULATION SERVED BY TRANSPORT MODE

Geospatial data and analysis

Point-base data for transport modes	Service areas - buffers *Euclidian distance*
Train stations for passengers	3 000 m
Metro stations	1 500 m
Boat stations (Lisboa)	3 000 m
Entrances to motorways	5 000 m

Point-base population data

Census 2011 georeferenced data

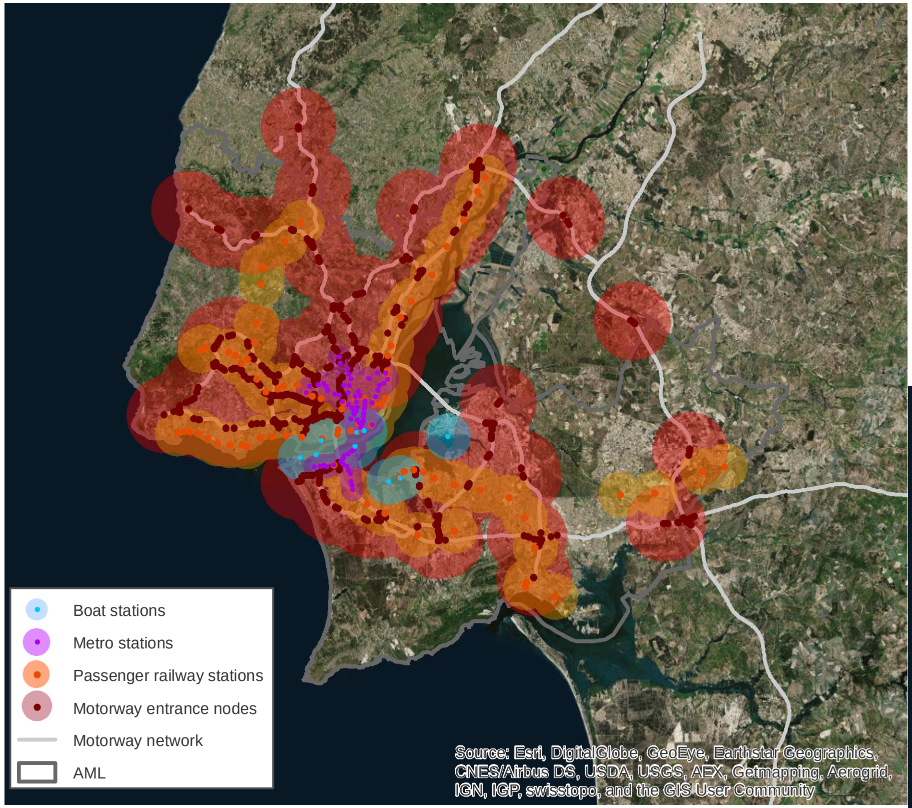
x, y coordinates at building level

POPULATION SERVED BY TRANSPORT MODE

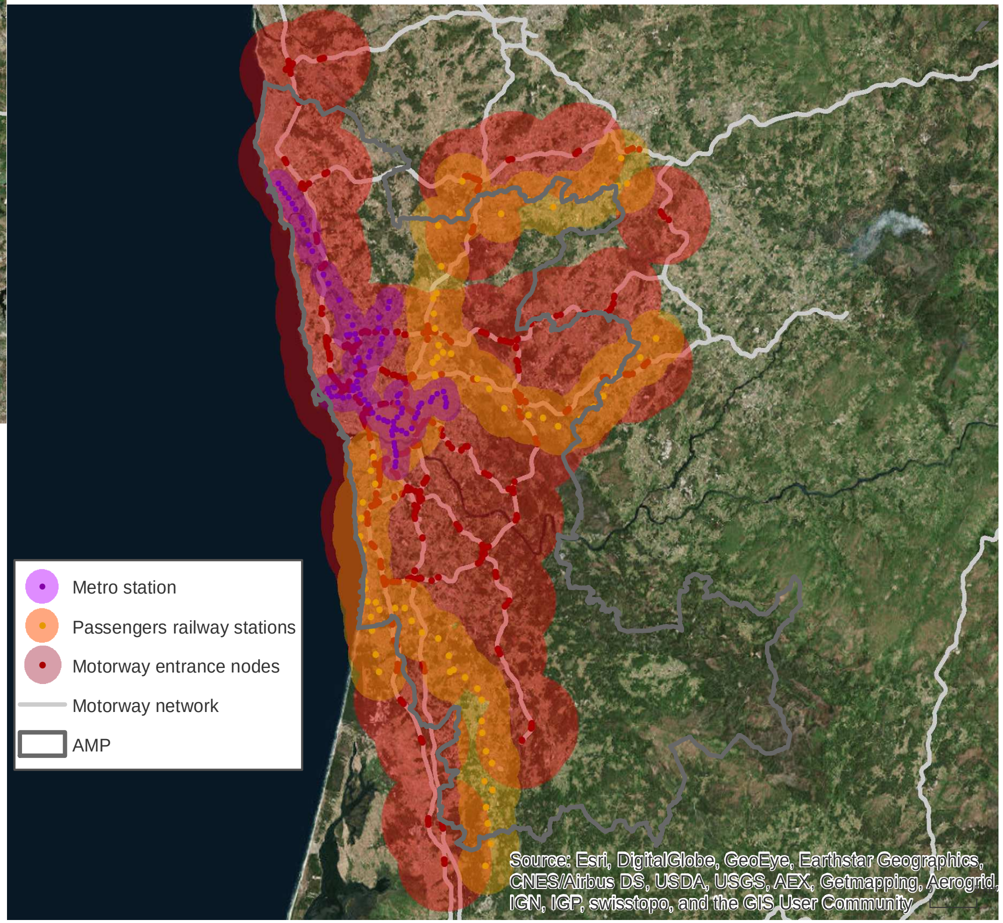
Geospatial data and analysis

Metropolitan Area	Transport mode	Transport entities	No of points	Buffer (m)	Parish (No)
Lisboa	Road	Motorway entrance nodes from localities	259	5 000	116
	Railway	Passenger railway stations	81	3 000	97
		Metro stations	69	1 500	40
	Fluvial	Boat stations	9	3 000	34
Porto	Road	Motorway entrance nodes from localities	235	5 000	155
	Railway	Passenger railway stations	80	3 000	47
		Metro stations	82	1 500	41

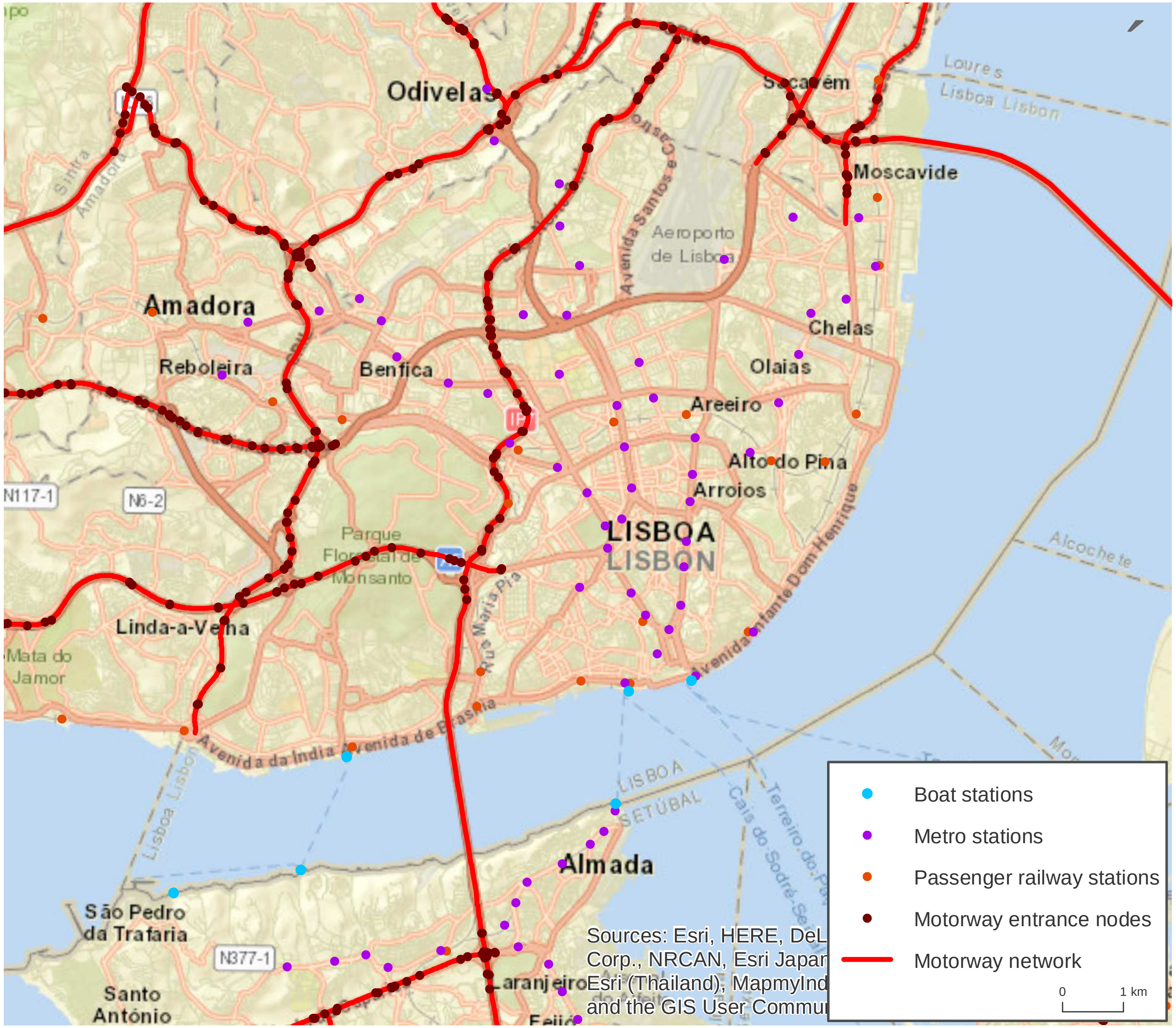
Lisbon Metropolitan Area



Porto Metropolitan Area

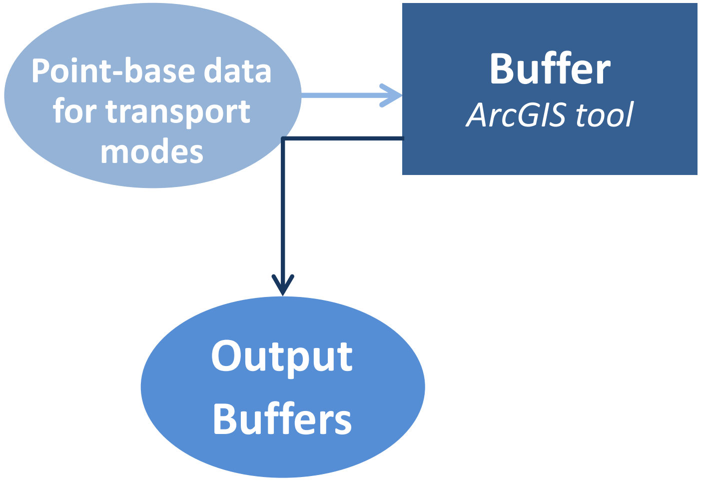


Point-base data for transport modes – example for *LISBON*

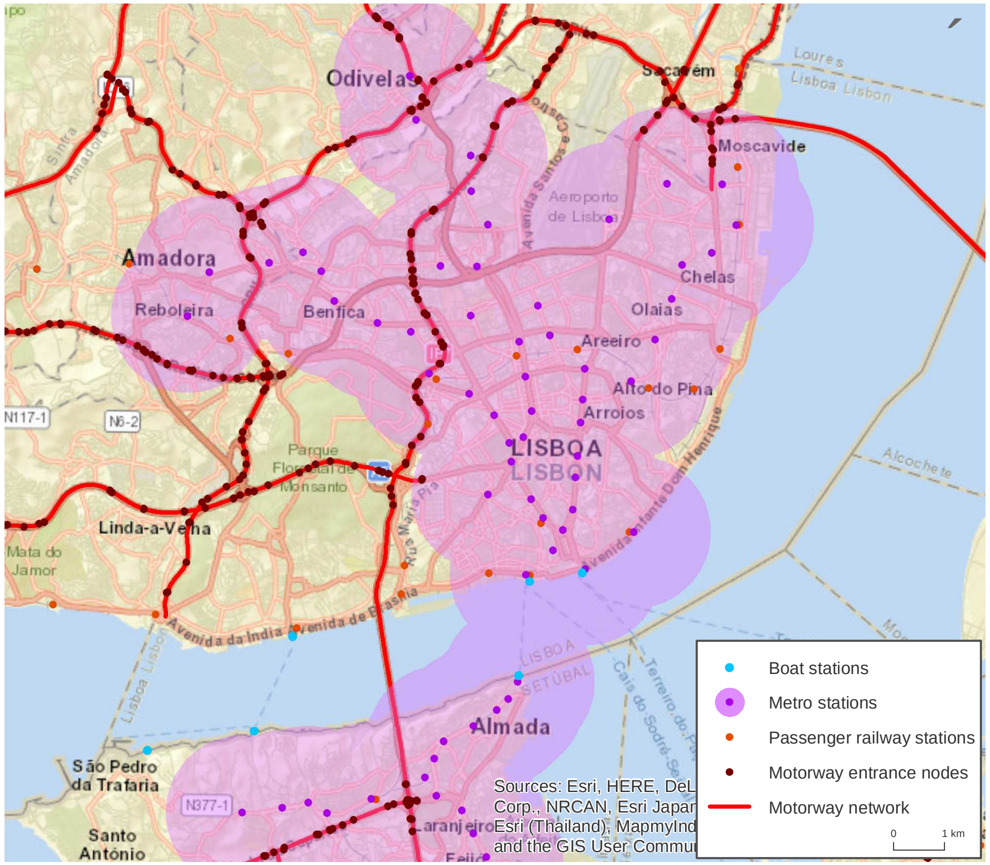


Population served by transport mode

Geospatial data and analysis



Example for Lisbon – metro buffers



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Population served by transport mode

Geospatial data and analysis

Point-base data for transport modes

Buffer
ArcGIS tool

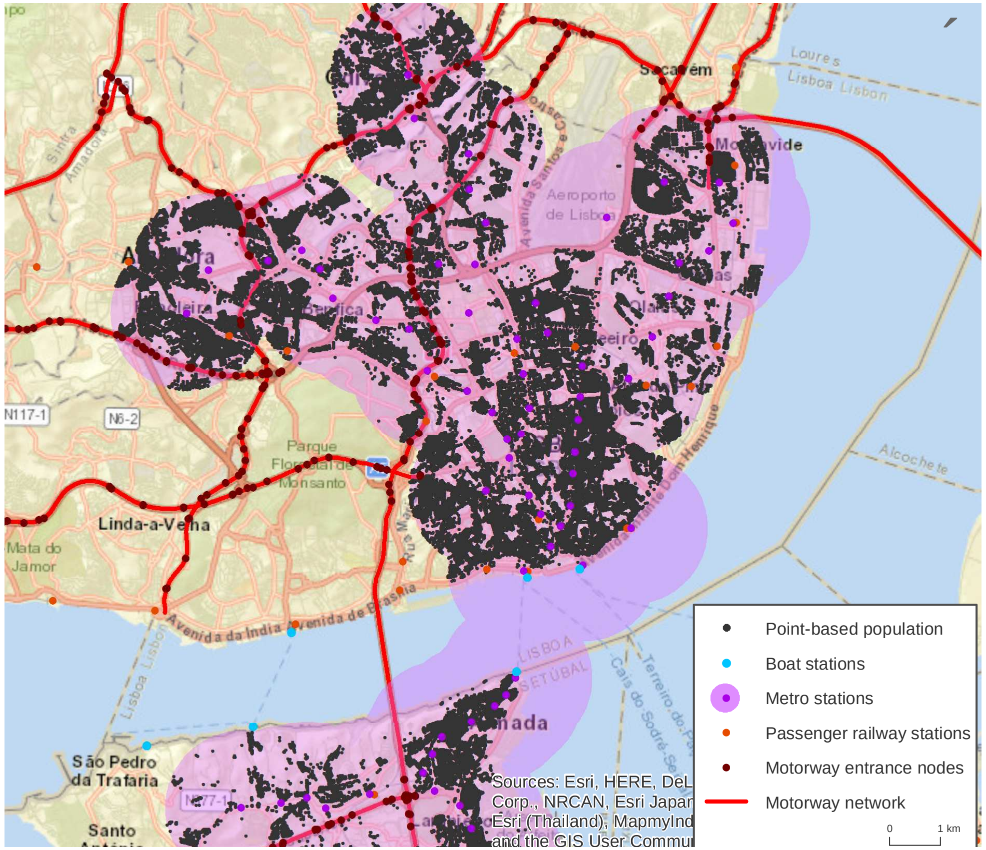
Point-based population

Output Buffers

Intersect
ArcGIS tool

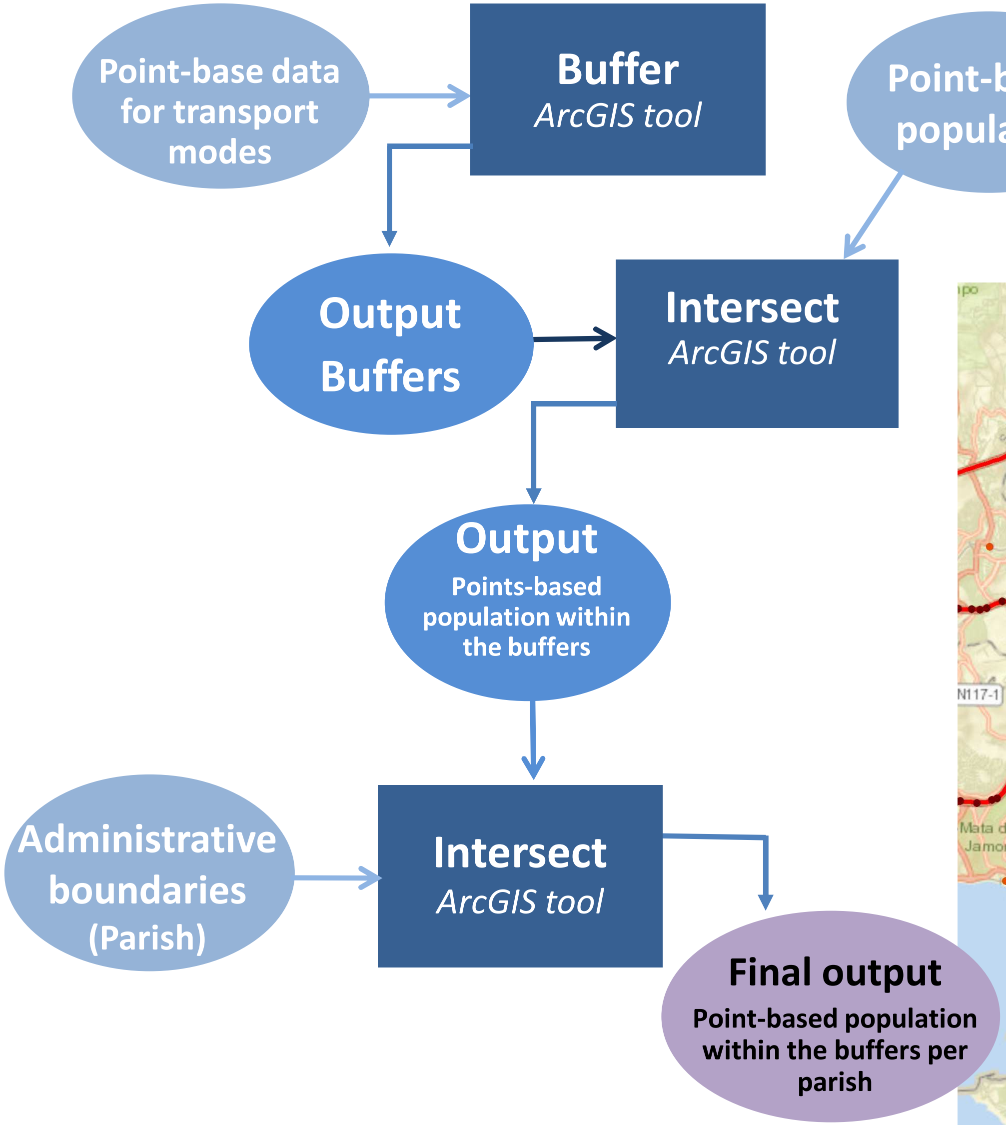
Output
Points-based population within the buffers

Example for Lisbon – metro buffers + point-based population

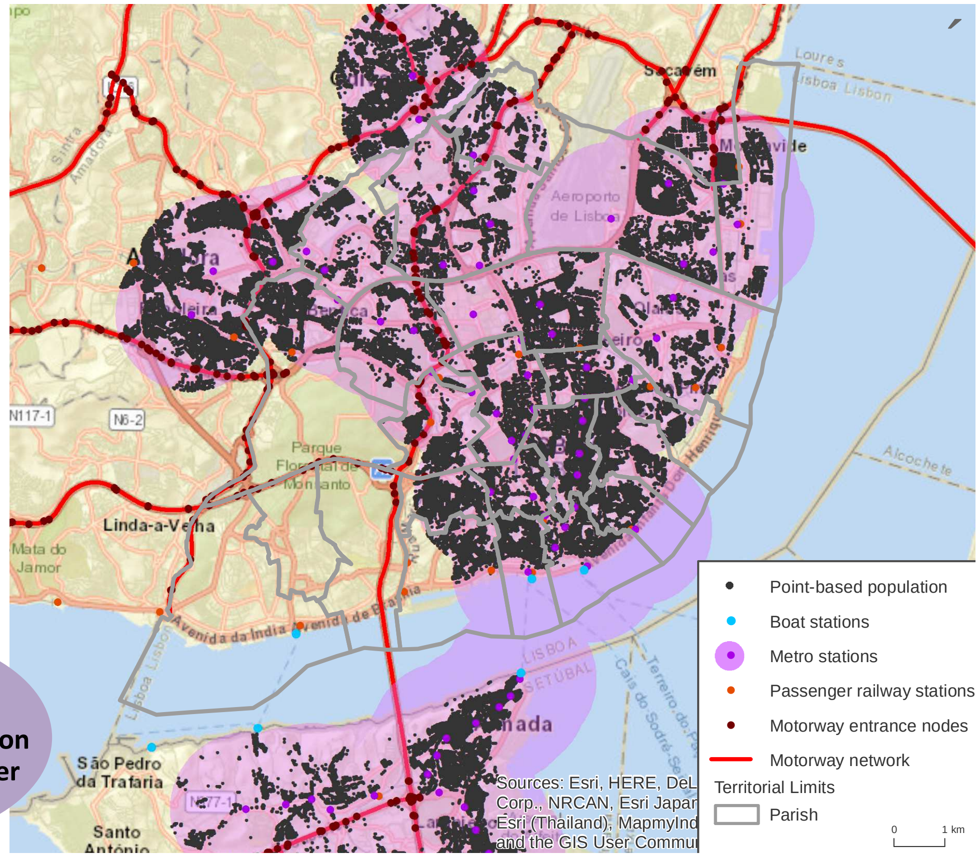


Population served by transport mode

Geospatial data and analysis



Example for Lisbon – metro buffers + point-based population + admin boundaries



POPULATION SERVED BY TRANSPORT MODE

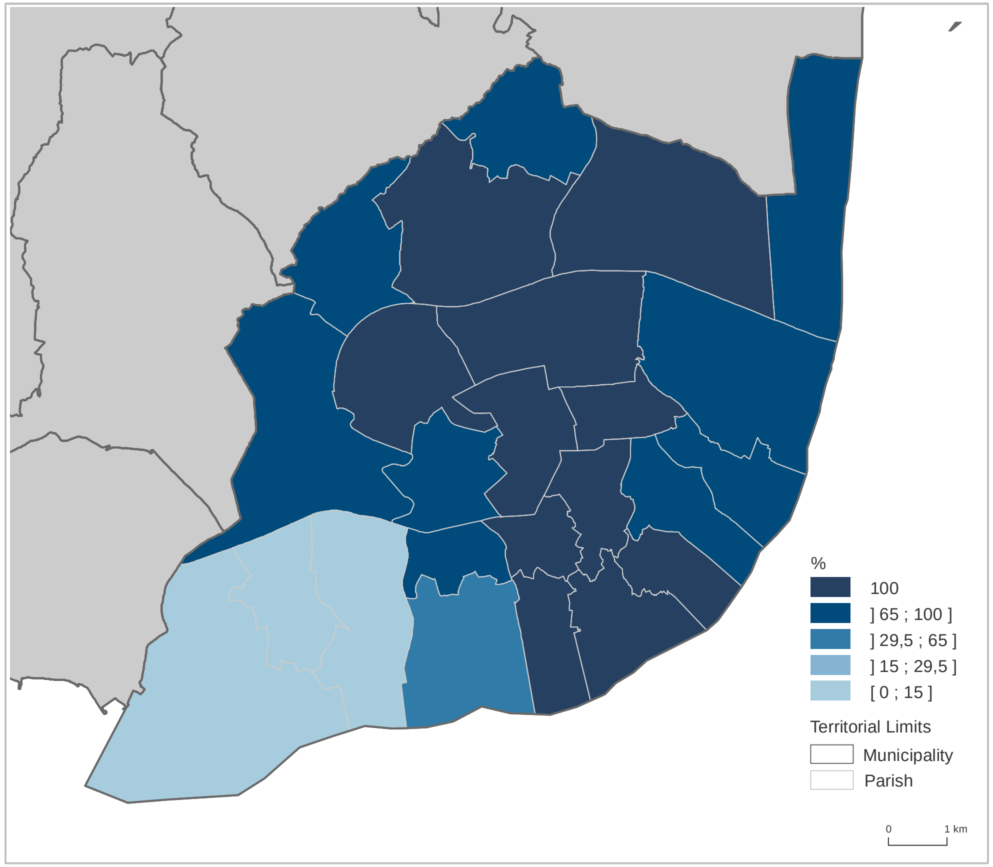
Geospatial data and analysis

Final output

Point-based population within the buffers per parish

$$= \frac{\textit{Population within the transport mode service area (buffer)}}{\textit{Total resident population}} \times 100$$

Example for Lisbon – Proportion of resident population served by a buffer of 1.5 km from a metro station by parish



POPULATION SERVED BY TRANSPORT MODE

Four input variables derived from geospatial data and analysis

1. % resident population served by a buffer of 5 km from a **motorway entrance node**

2. % resident population served by a buffer of 3 km from a **train station for passengers**

3. % resident population served by a buffer of 1.5 km from a **metro station**

4. % resident population served by a buffer of 3 km from a **boat station** (only for the Lisbon Metropolitan Area)

2011 CENSUS COMMUTING INDICATORS

- **Average time spent commuting** (minutes)
- **Proportion of resident population working or studying in another municipality** (%)
- **Proportion of employed or student resident population that goes to work mainly by** (%) **:**

Car

Metro

Train

Boat

Calculated at parish level (according to new geography defined in 2013 – after the 2011 Census round)

The point-based population (at building level) allowed the compatibility of geographies at micro-data level

METHODOLOGY

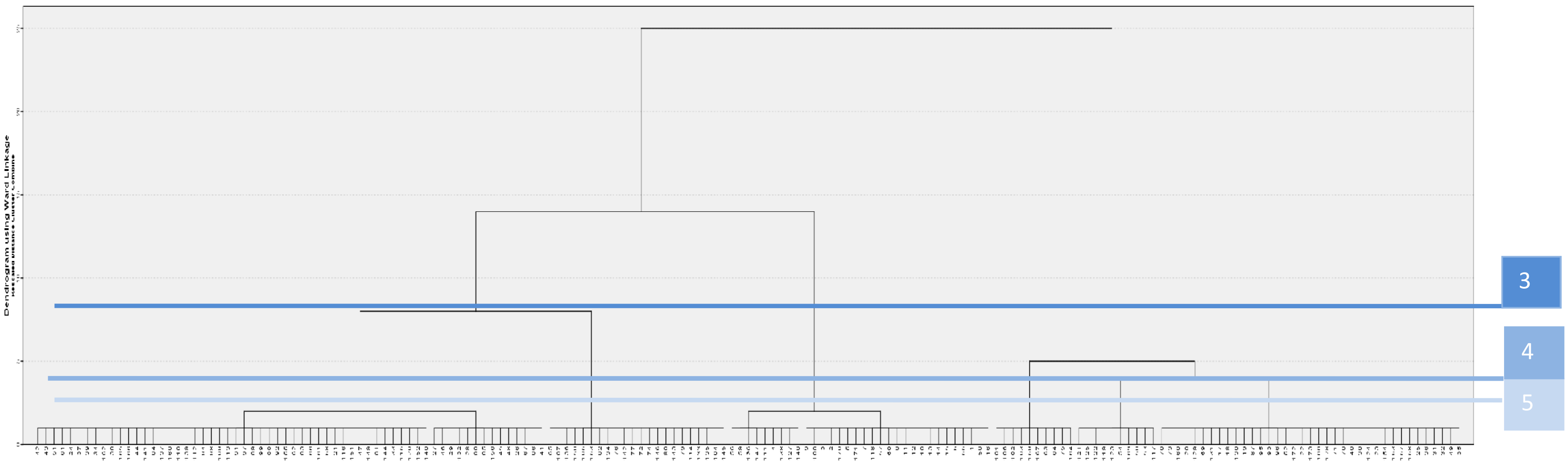
METHOD

- **10 input variables:** **4** Population served by transport mode and **6** 2011 Census commuting indicators
- **Analysis unit: parish** 118 in Lisbon Metropolitan Area and 173 in Porto Metropolitan Area
- **Cluster analysis:** multivariate data analysis technique – this type of analysis makes it possible to group in a reduced set of clusters the territorial units (parishes) that share similar characteristics
- **Hierarchical method:** it does not require to *a priori* define the number of clusters (inductive method based on tree analysis - dendrogram) . Ward aggregation method
- **Independent classification processes for each metropolitan area:** two datasets analysed separately in SPSS environment
- **Complemented by expert sensitivity analysis**

METHOD

- **For each metropolitan area an analysis of the dendrogram was carried out and different clusters solutions were compared:**
  - Number of areas by municipality
  - Distribution of population by area in each municipality
  - Expert sensitivity analysis
  - Spatial contiguity

Example of a tree map – dendrogram



RESULTS

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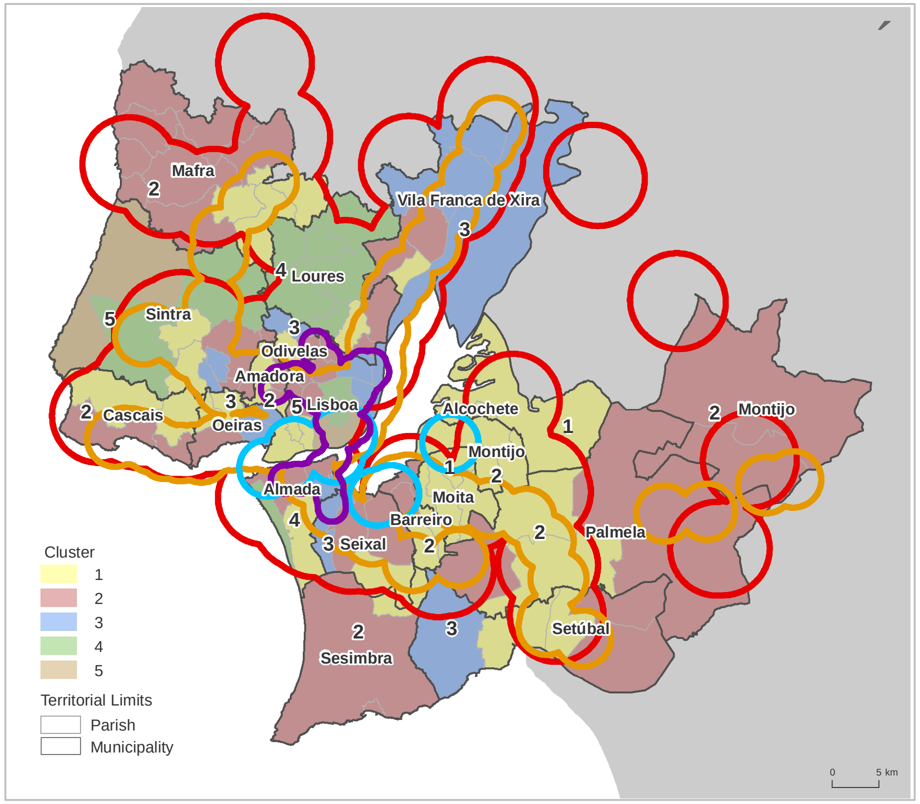
Results

Lisbon Metropolitan Area

- Final proposal – **49 metropolitan areas below the municipality level**
- Majority of the areas → groups by the clusters analysis
- **7** municipalities → total or partial *ad hoc* adjustments

Municipality	Total	Population by metropolitan areas				
		1	2	3	4	5
Alcochete	17 569	17 569				
Almada	174 030	44 929	75 811	39 872	13 418	
Amadora	175 136	86 263	88 873			
Barreiro	78 764	15 127	63 637			
Cascais	206 479	99 664	106 815			
Lisboa	552 700	46 088	157 331	105 343	132 518	111 420
Loures	199 494	34 943	69 153	21 891	73 507	
Mafra	76 685	25 135	51 550			
Moita	66 029	66 029				
Montijo	51 222	45 620	5 602			
Odivelas	145 142	34 143	78 418	32 581		
Oeiras	172 120	29 018	58 149	84 953		
Palmela	62 831	29 346	33 485			
Seixal	158 269	17 059	93 549	47 661		
Sesimbra	49 500	25 606	23 894			
Setúbal	121 185	90 640	11 668	18 877		
Sintra	377 835	113 561	113 957	79 805	46 379	24 133
Vila Franca de Xira	136 886	40 404	57 153	39 329		
Total	2 821 876	861 144	1 089 045	470 312	265 822	135 553

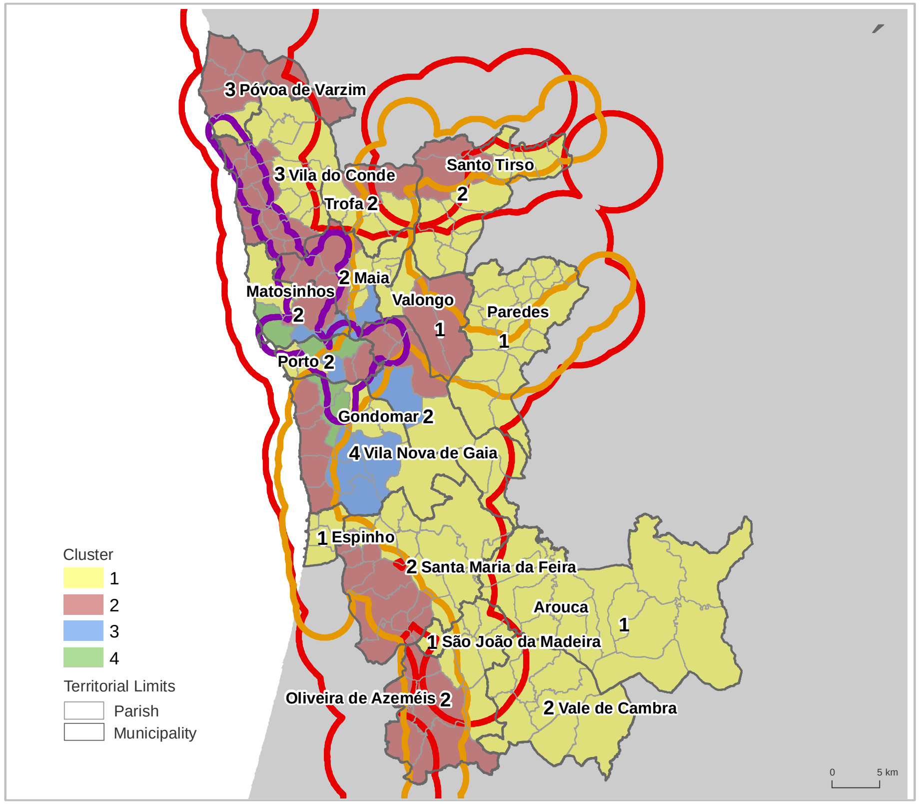


Results

Porto Metropolitan Area

- Final proposal – **38 metropolitan areas below the municipality level**
- Majority of the areas → groups by the clusters analysis
- **11** municipalities → total or partial *ad hoc* adjustments

Municipality	Population by metropolitan areas				
	Total	1	2	3	4
Arouca	22 359	22 359			
Espinho	31 786	31 786			
Gondomar	168 027	15 026	104 401	48 600	
Maia	135 306	18 382	77 305	39 619	
Matosinhos	175 478	29 407	45 716	50 869	49 486
Oliveira de Azeméis	68 611	24 423	44 188		
Paredes	86 854	51 497	35 357		
Porto	237 591	57 917	56 924	40 440	82 310
Póvoa de Varzim	63 408	34 266	29 142		
Santa Maria da Feira	139 309	71 605	67 704		
Santo Tirso	71 530	39 829	31 701		
São João da Madeira	21 713	21 713			
Trofa	38 999	17 414	21 585		
Vale de Cambra	22 864	22 864			
Valongo	93 858	54 009	39 849		
Vila do Conde	79 533	22 302	57 231		
Vila Nova de Gaia	302 298	69 203	86 886	60 073	86 136
Total	1 759 524	604 002	697 989	239 601	217 932



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Thank you very much for your attention

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