DEFINING THE ECONOMIC BOUNDARIES OF CITIES

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BETTER POLICIES FOR BETTER LIVES

Problem and approach

- A **functional urban area** (**FUA**): place where **one person** is likely to meet **any other** person within **the same day**
- **Boundaries** based on **administrative borders** of single municipalities do not accurately represent FUAs
- EC-OECD **FUAs**: Define **commuting zone** around **urban centres (UCs)** based on commuting intensity
- **Problem**: Find a way to define commuting zones in places where there is no commuting data
- **Approach:** make the most of the FUAs we know to learn about the ones we do not know

EC-OECD FUAS

EC-OECD Functional Urban Areas (FUAs)

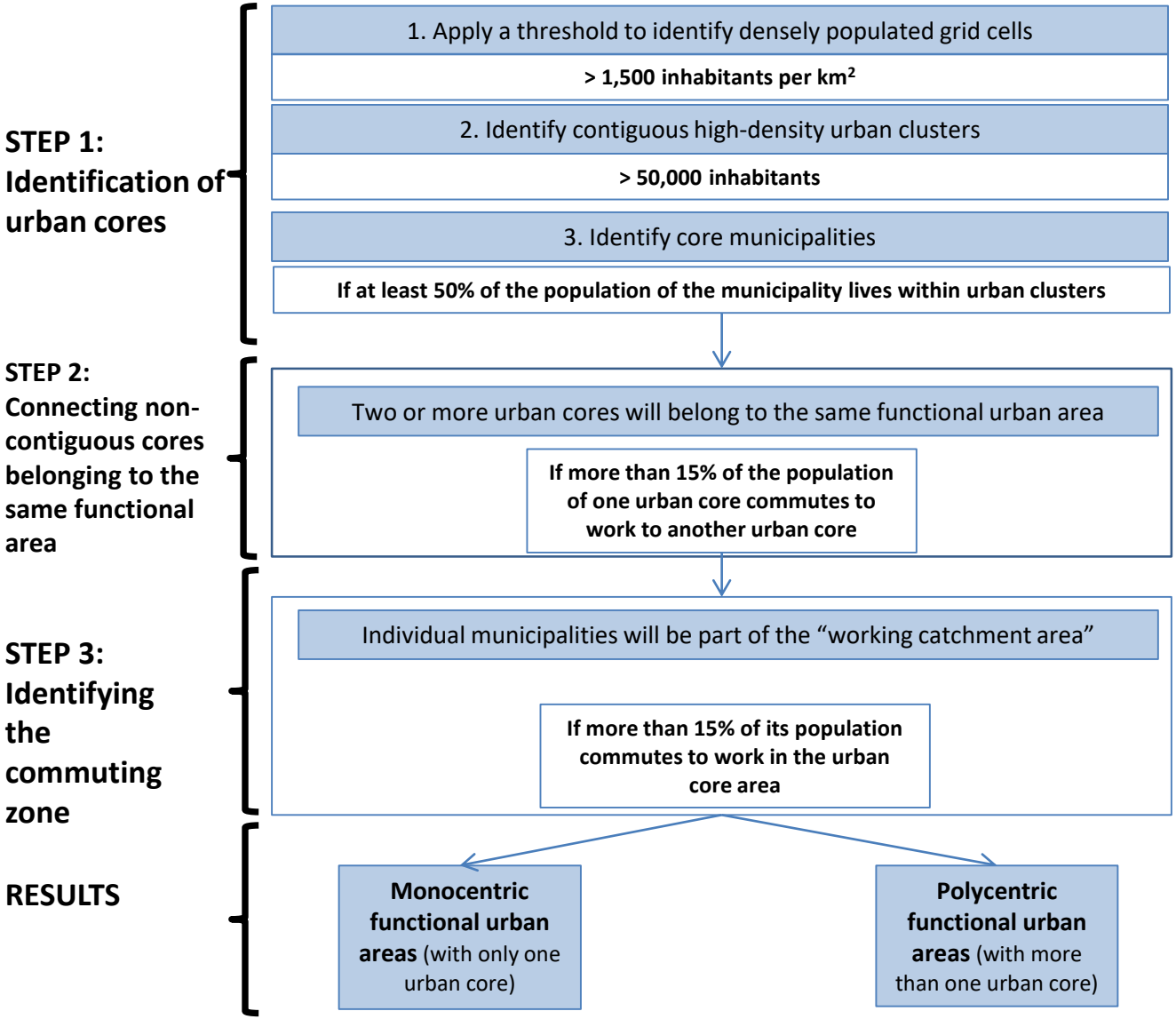
Main characteristics

- Based on people and their **daily behaviour** instead of administrative or purely morphological approaches
- (Partially) overcome administrative boundaries
- Facilitate international comparisons
- Support the design of urban policy and governance solutions

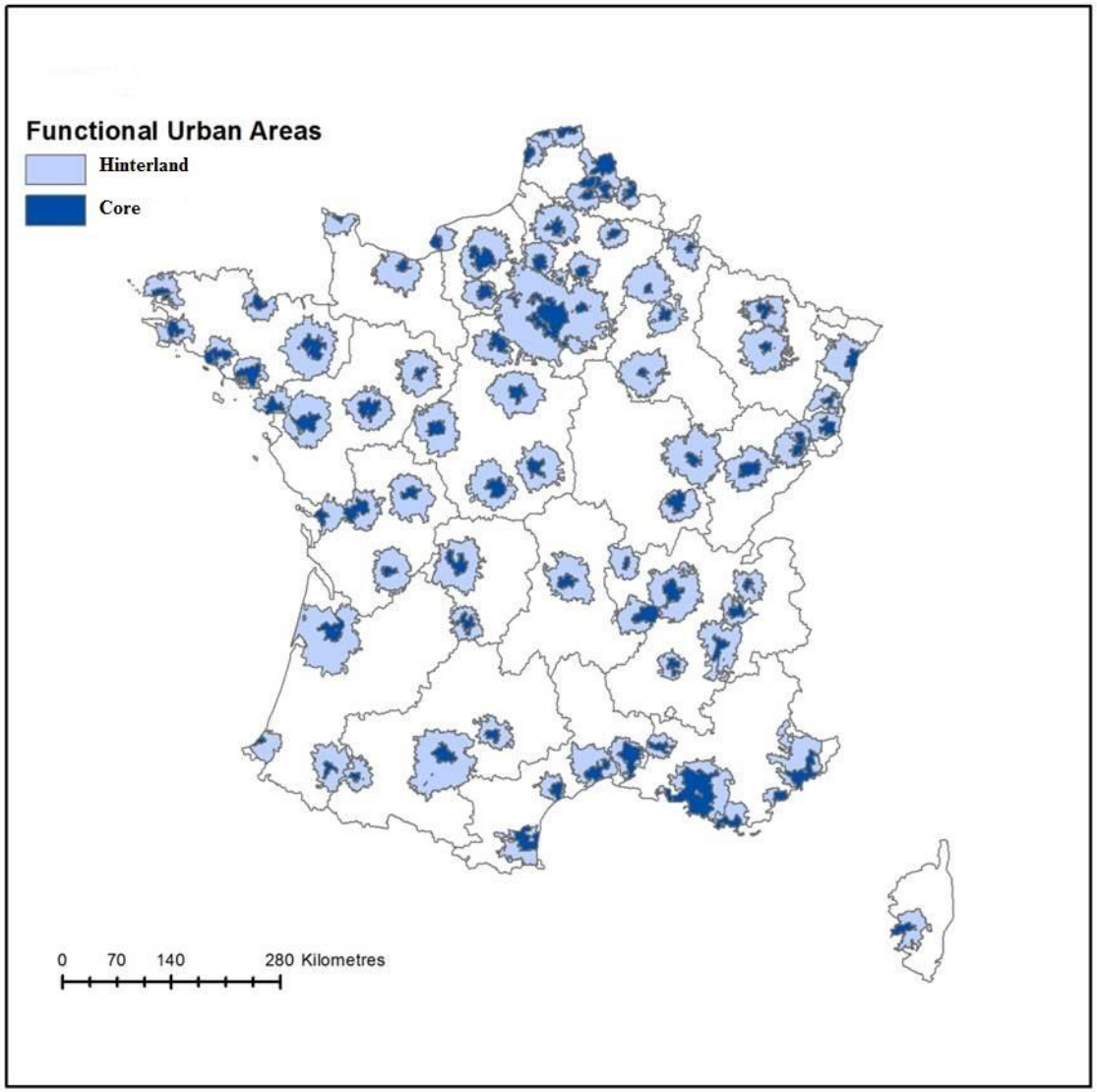
Method developed in cooperation with the EU in 2012

- Identified 1,197 FUAs in **33 OECD countries + Colombia**
- **Replicable** methodology for non-OECD countries

Defining Functional Urban Areas



Example: French FUAs



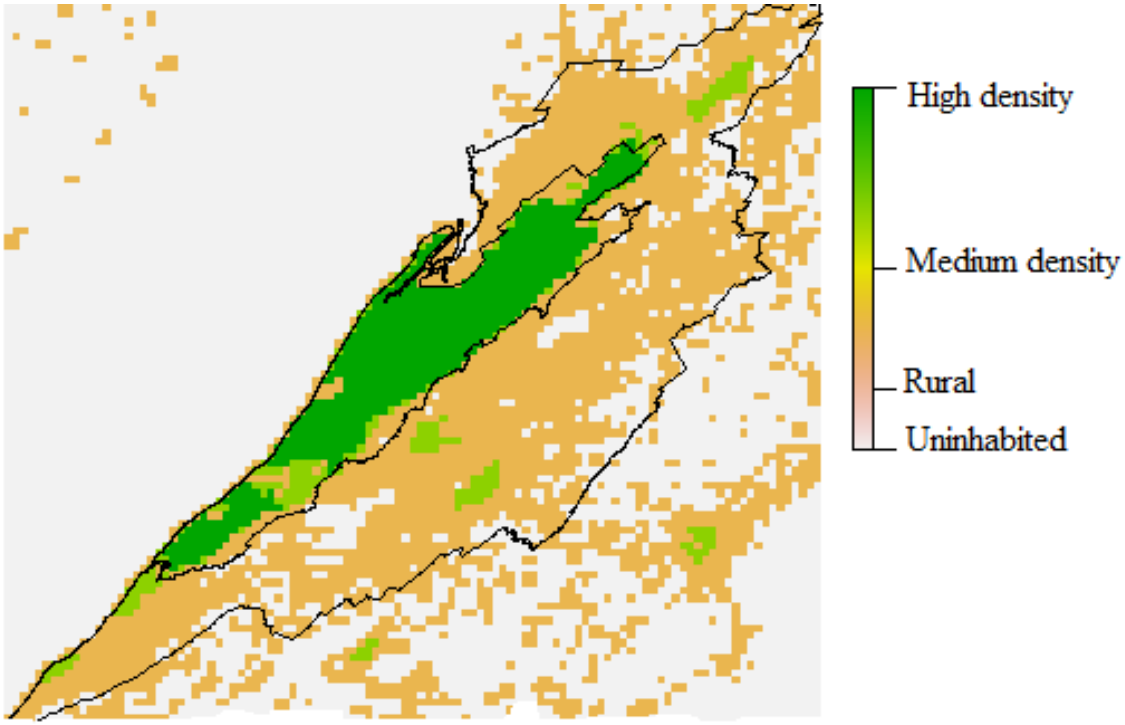
- 83 FUAs identified
- Total population in 2011 ranges from 85,000 to 11.7 million (Paris)
- 65% of French population live in FUAs (Paris represents 19%)

MODELLING FUAS OUTSIDE OECD COUNTRIES

Departing point: What is inside FUAs?

Open!

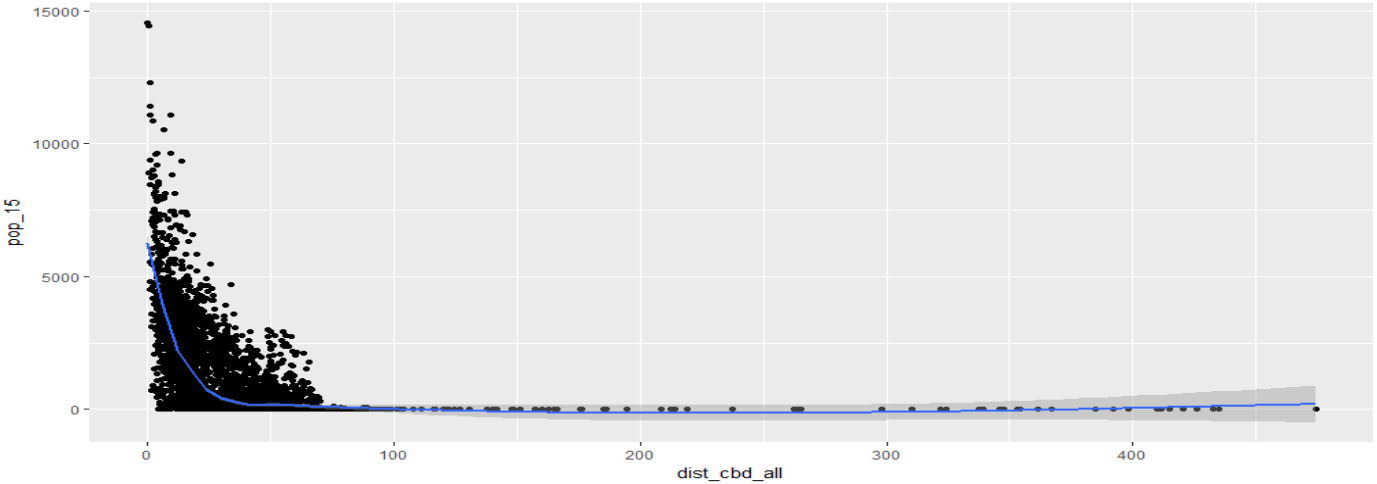
We use the **Global Human Settlements Population Layer** (GHSL) and **Population Model** (SMOD) produced by JRC, containing population by 1km2 cells to characterize points inside FUAs



FUA Boundaries + SMOD, Adelaide (AU)

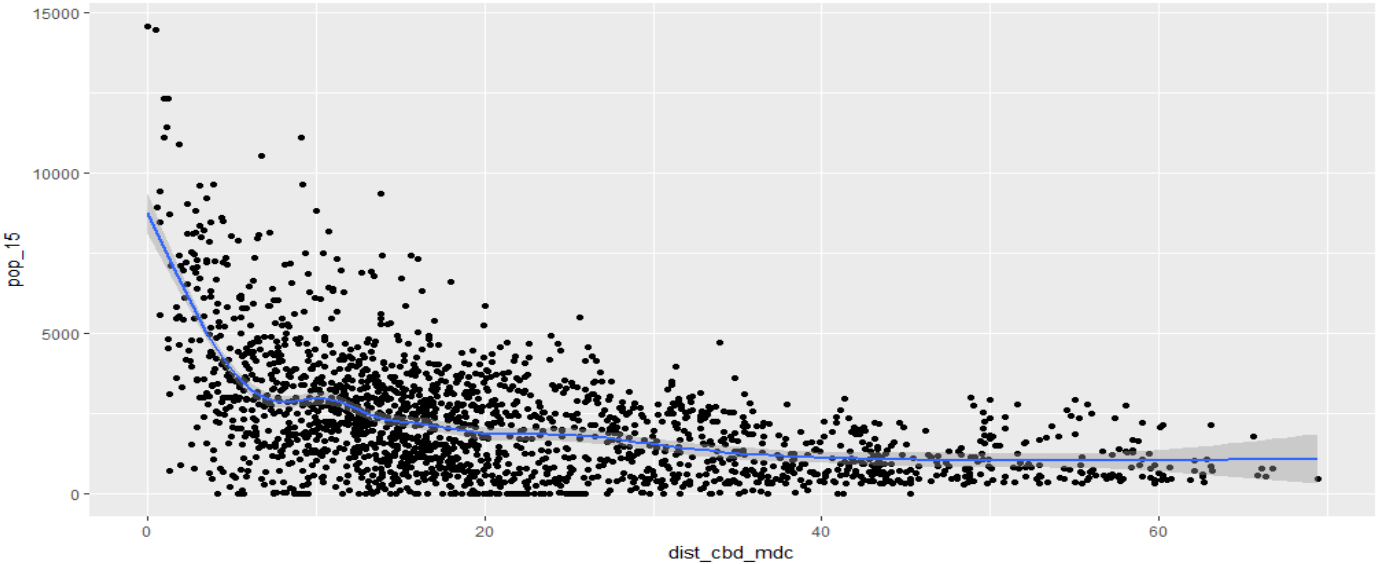
Medium density area, Vienna (AT)

Should we consider all cell types?



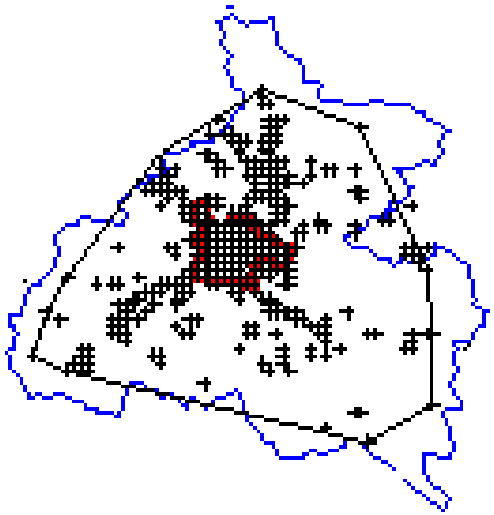
1) All cells

Distance to highest density cell versus population, Sydney

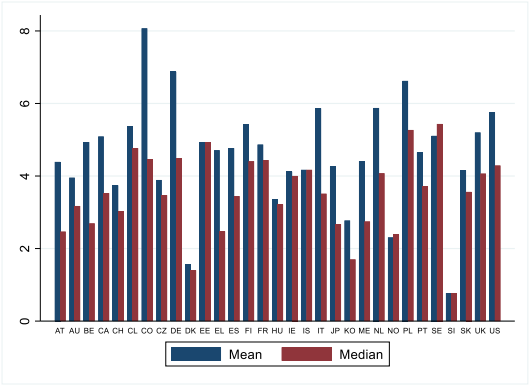


2) **Medium density** cells

Is it OK to exclude rural cells?

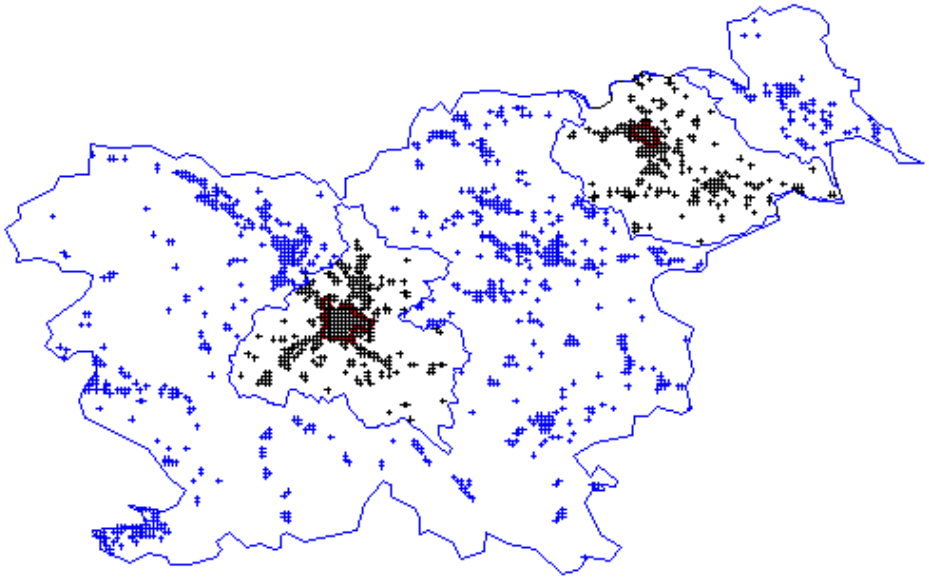


Ljubljana, actual versus convex hull border based on medium density cells



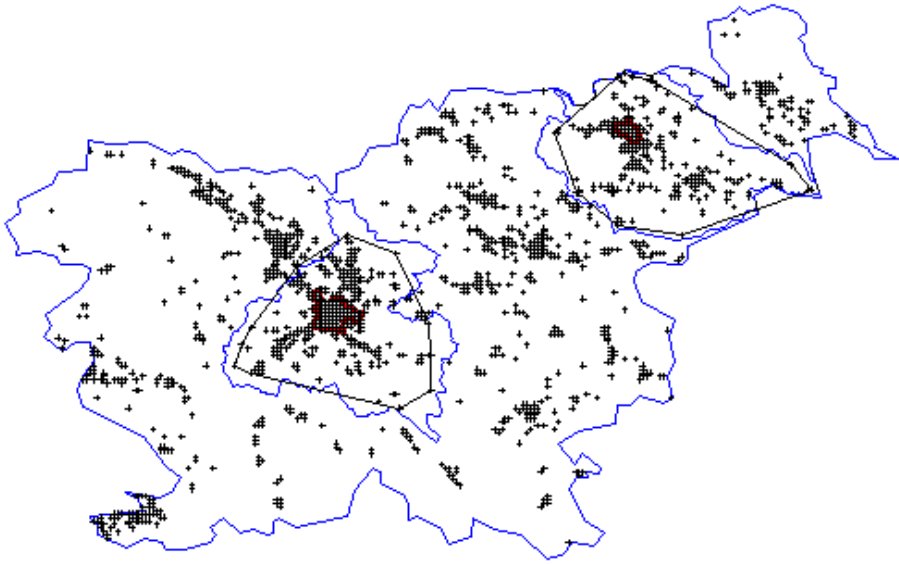
Predicted vs. actual FUA population, differences (%) by country)

Method steps: Estimation



1. Subset grid-cells with population >300 inhabitants in each country (**medium density** cells)
2. Identify cells falling within FUA borders (dummy_FUA=1 (black), 0 (blue) otherwise)
3. Calculate the distance of each cell to the closest **urban centre**

4. Pool data for all countries and estimate a logistic regression of dummy_FUA on distance + size of the **urban centre** + size of cell + country controls (~ 0.5 million obs.) to estimate the probability that a cell = 1



Estimating travel times

We use the *costDistance* function of the R *gdistance* package (van Etten 2017) to obtain travel times between the centroid of each **urban cluster** and each **medium density** cell within country borders using:

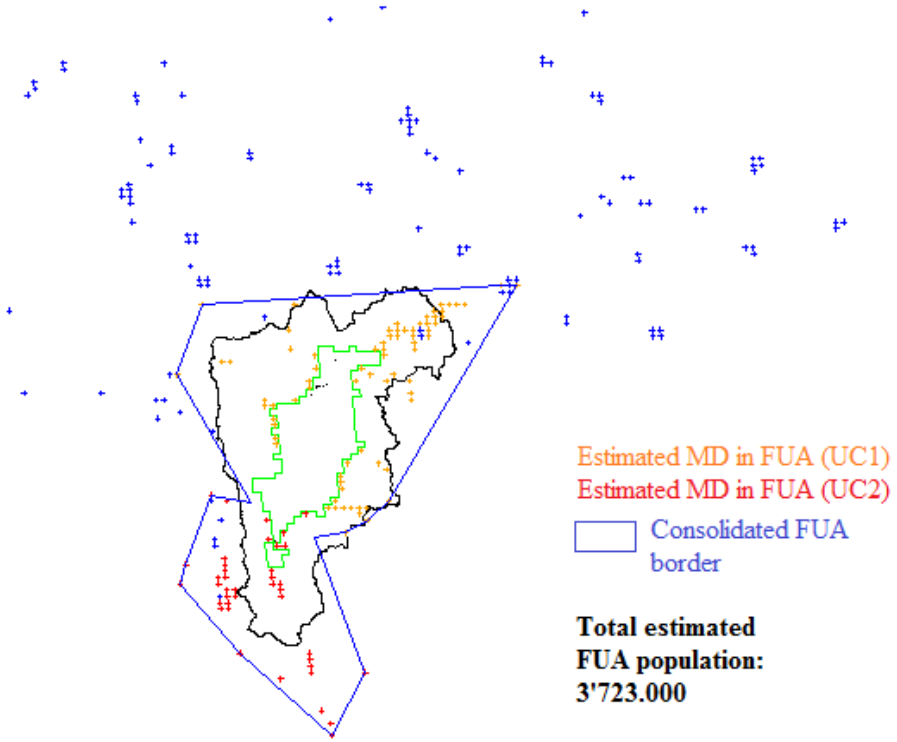
1) **Global travel impedance grid** (https://map.ox.ac.uk/):

- Represents time associated with moving through grid cells, quantified as a movement speed within a "**friction**" grid (30 arcsec resolution). Unit of measurement in grid is **minutes** required to travel **one kilometre**
- Information on roads (fastest type in grid takes precedence over others, with speeds given by OSM tables), railroads, water bodies and movement over land is used to characterize each grid cell

2) **GAUL country boundaries** (FAO)

IMPLEMENTATION

Implementation steps

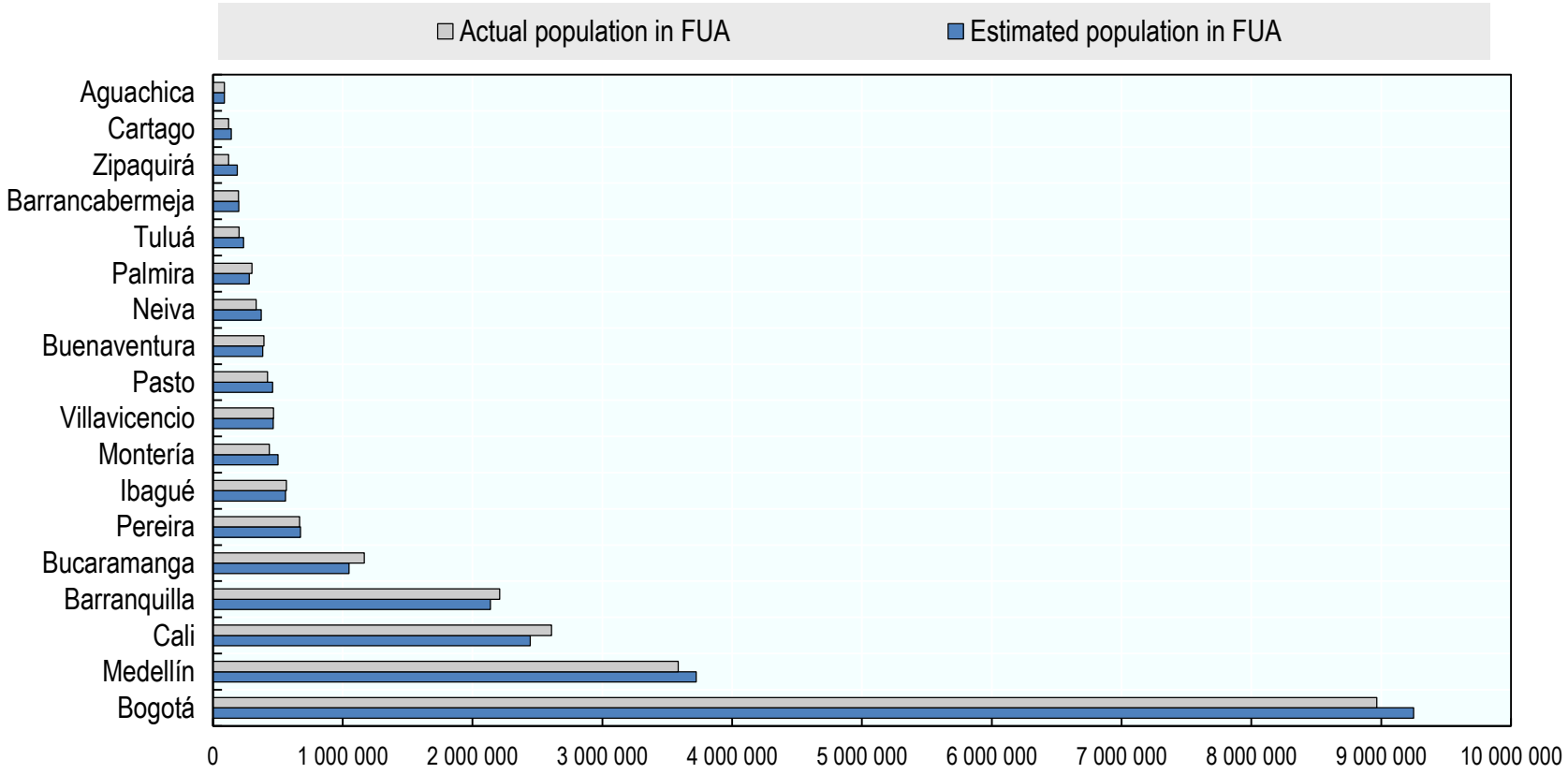


Medellín (CO), actual vs estimated FUA borders

1. Calculate distance from all **medium density cells** to all **urban clusters** within country borders
2. Assign **medium density** cells to most proximate **urban cluster**
2. Assign =1 to **medium density** cell if predicted probability < 0.75 (based on estimated coefficients)
3. Draw FUA border based on cells = 1
4. Merge borders if an estimated FUA border crosses an **urban cluster** (polycentric FUAs)

Performance: Colombia

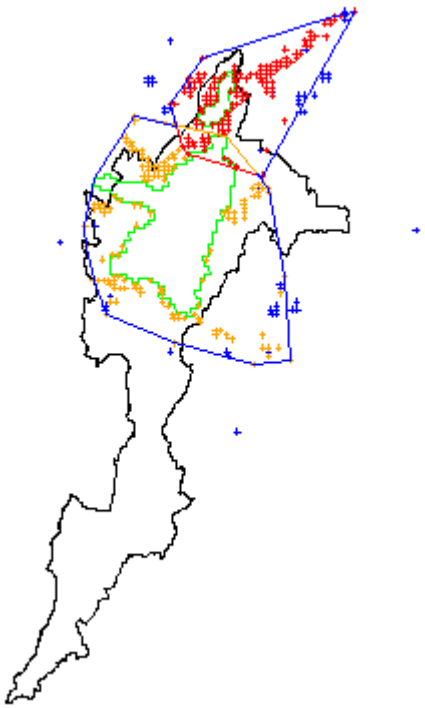
Accuracy of models using all countries except Colombia as training set and Colombia as test set: ~80% (average all countries: ~ 75%)



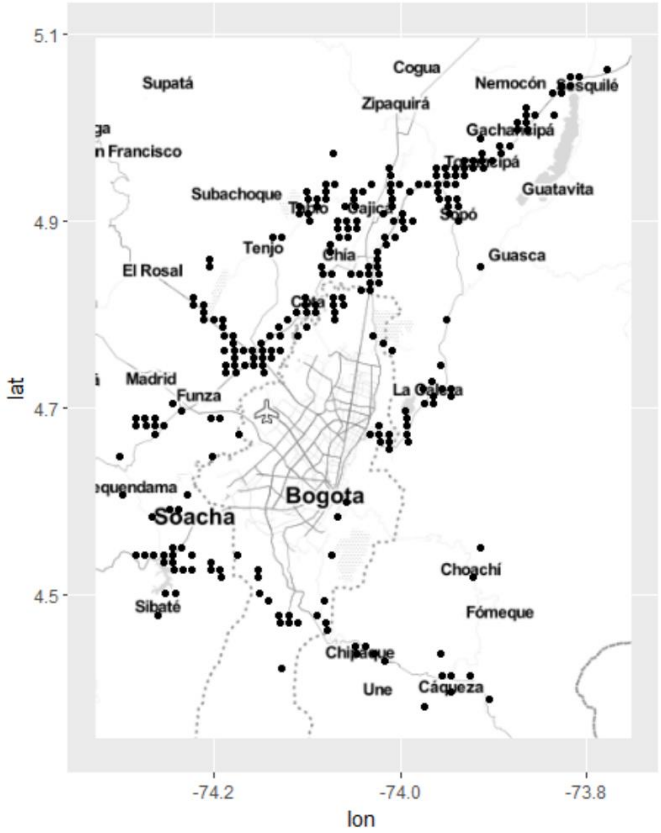
Actual vs estimated FUA population, selected cities, Colombia

Estimated borders: Bogotá

Objective is **not** to reproduce actual **border lines** but to approximate population in the commuting zone of urban clusters



Actual vs estimated FUA border, Bogotá, Colombia



Estimated MD cells = 1

Next steps

- Test stability of method to different specifications
- Implement method outside OECD (preliminary tests conducted for Tunisia, Morocco and Thailand)
- Define additional rules in case estimated FUAs become unrealistically large
- Use estimated FUA borders to understand suburbanization patterns

Thank you!

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