Urban emission inventory for Coimbra (PT) case study: What we need for policy-related applications?

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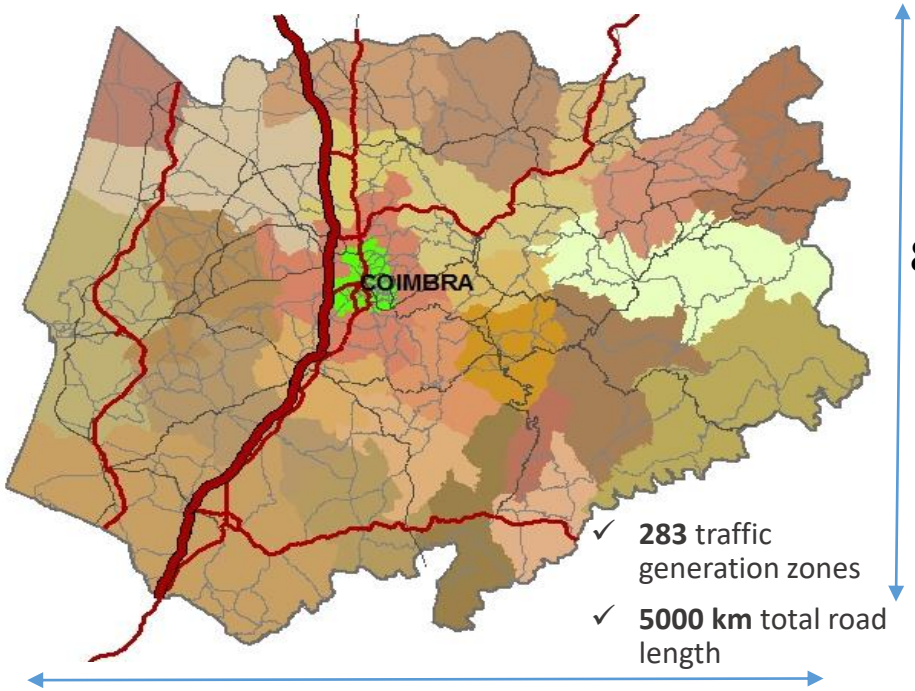
Key points:

1. What is the quality of our emission data?

2. Is our data fit the purpose?

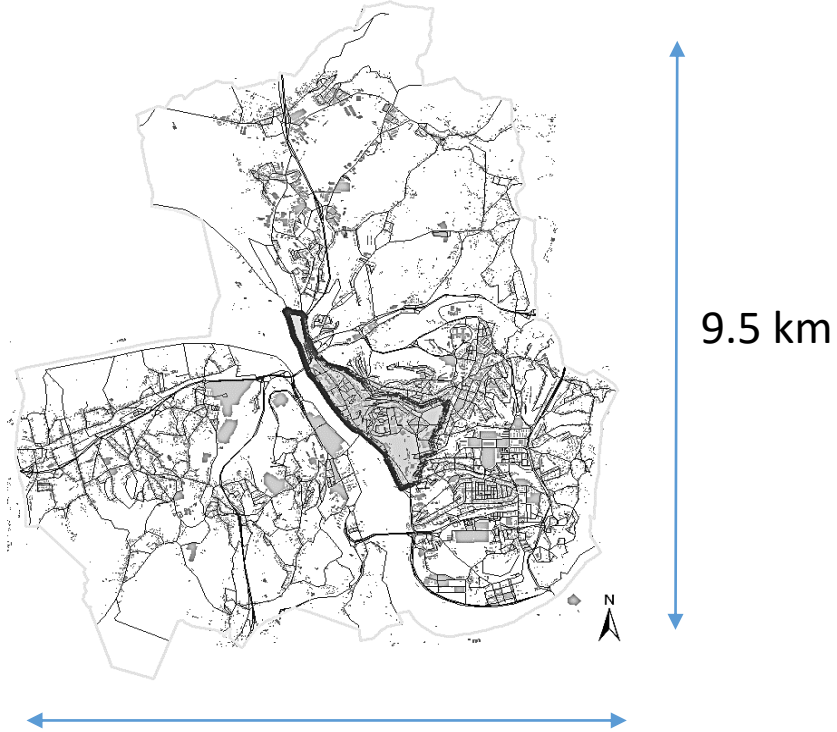
Study domain

Coimbra Region



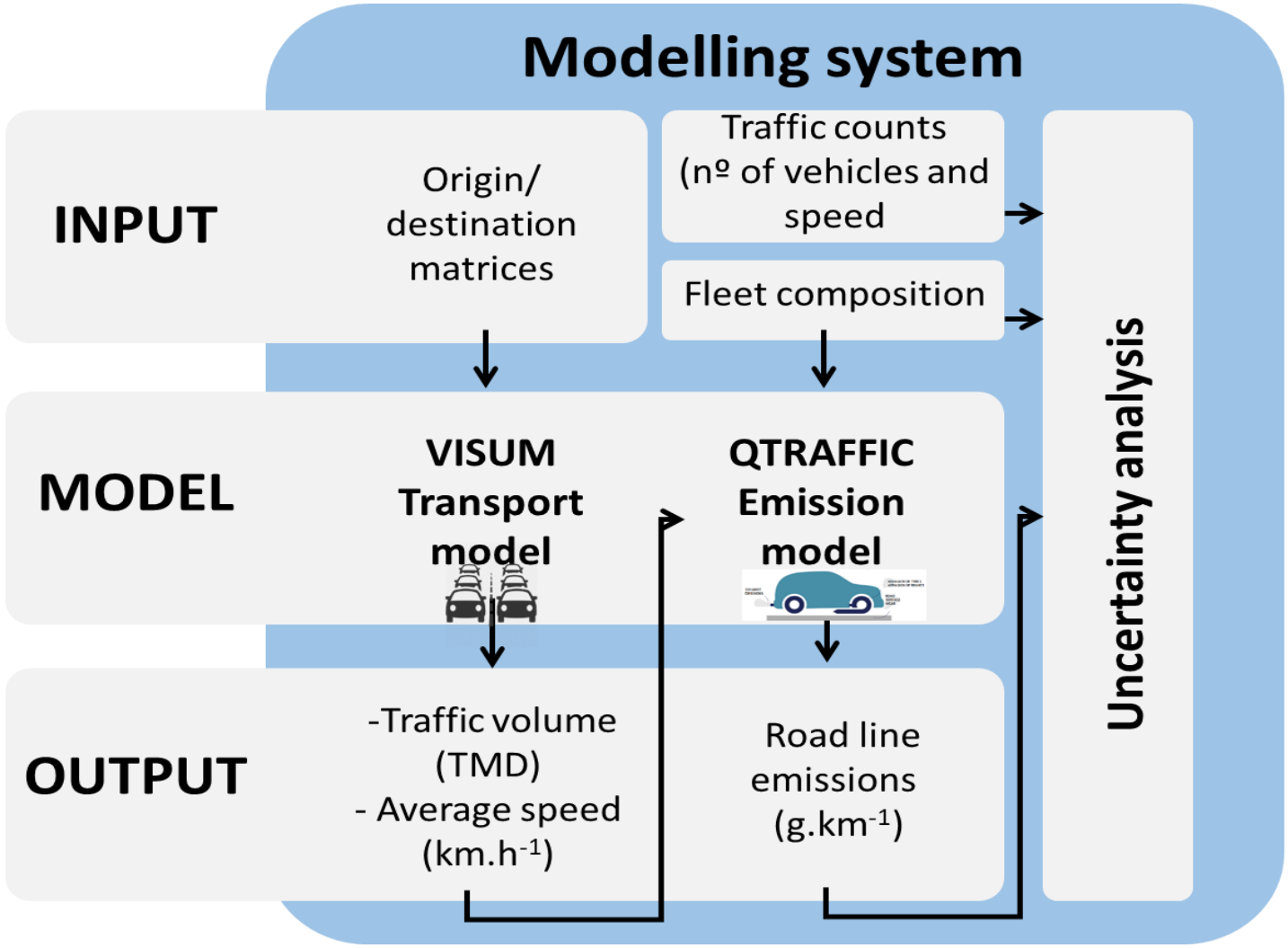
Population - 576 500 inhabitants

Coimbra Urban area



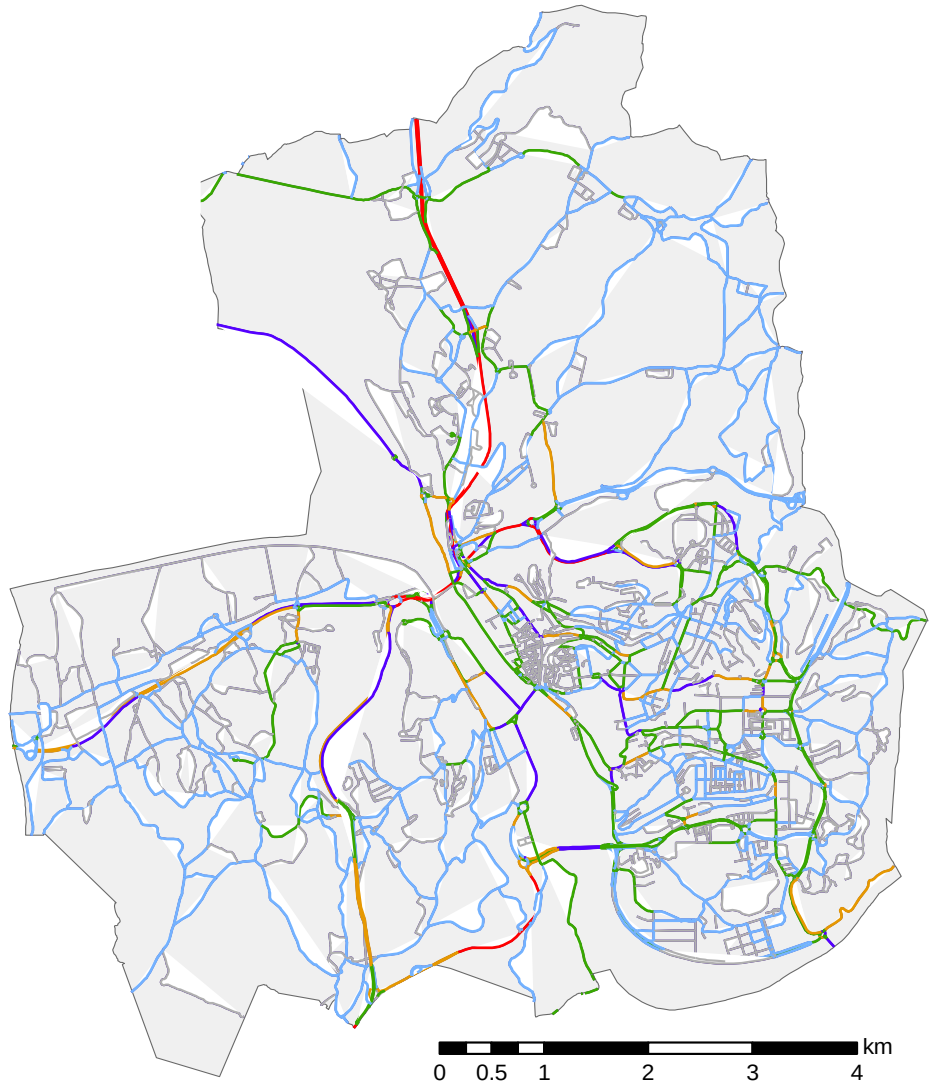
Population - 115 000 inhabitants

Methodology



Results

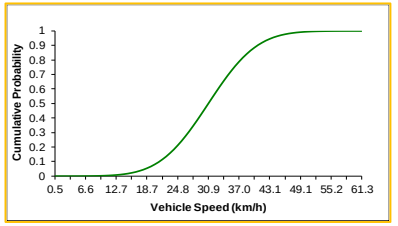
Spatial distribution of PM2.5 emissions



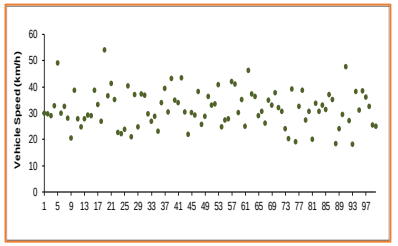
Uncertainty analysis: Monte Carlo approach

Step 1: Define the distribution function

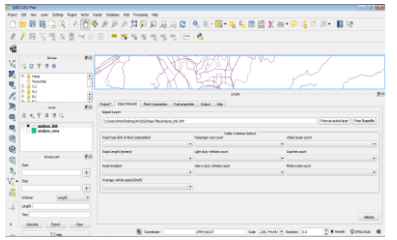
- Vehicle classes
- Traffic volume
- Vehicle speed



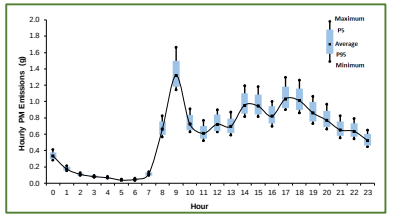
Step 2: Generation random numbers



Step 3: Calculate emissions by the model



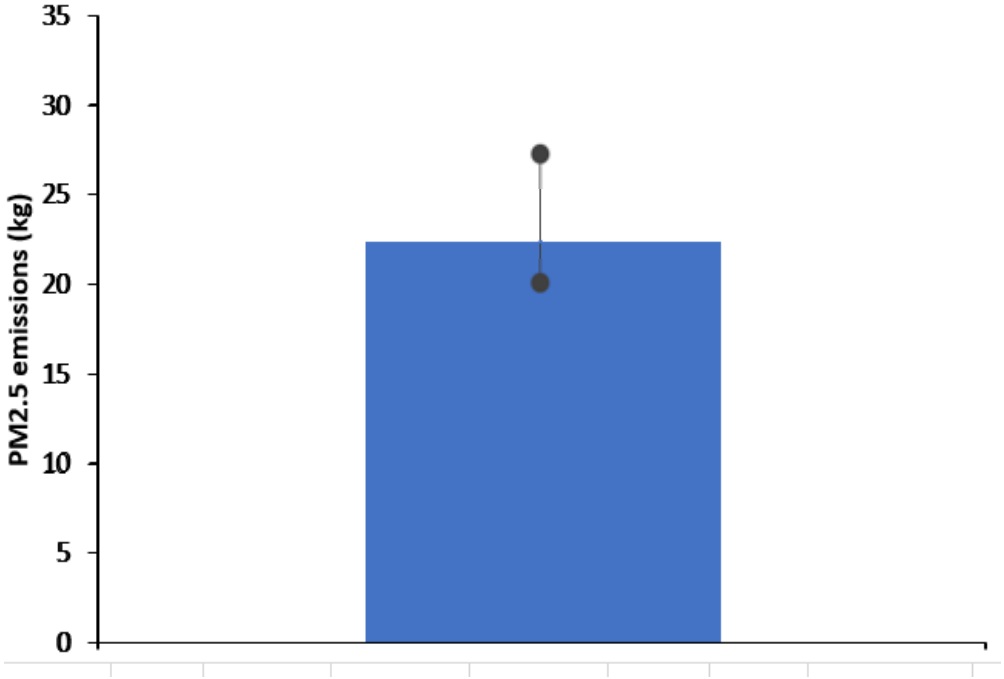
Step 4: Analysis of the emission data



Uncertainty analysis: Monte Carlo approach

Based on outputs for each road segments ➡ Daily total emissions

Daily total $PM_{2.5}$ emissions for the Coimbra urban area



Uncertainty range	
(-)	(+)
-13%	24%

$$(-) = \left(\frac{(5th\ percentile - average)}{average}\right) \times 100$$

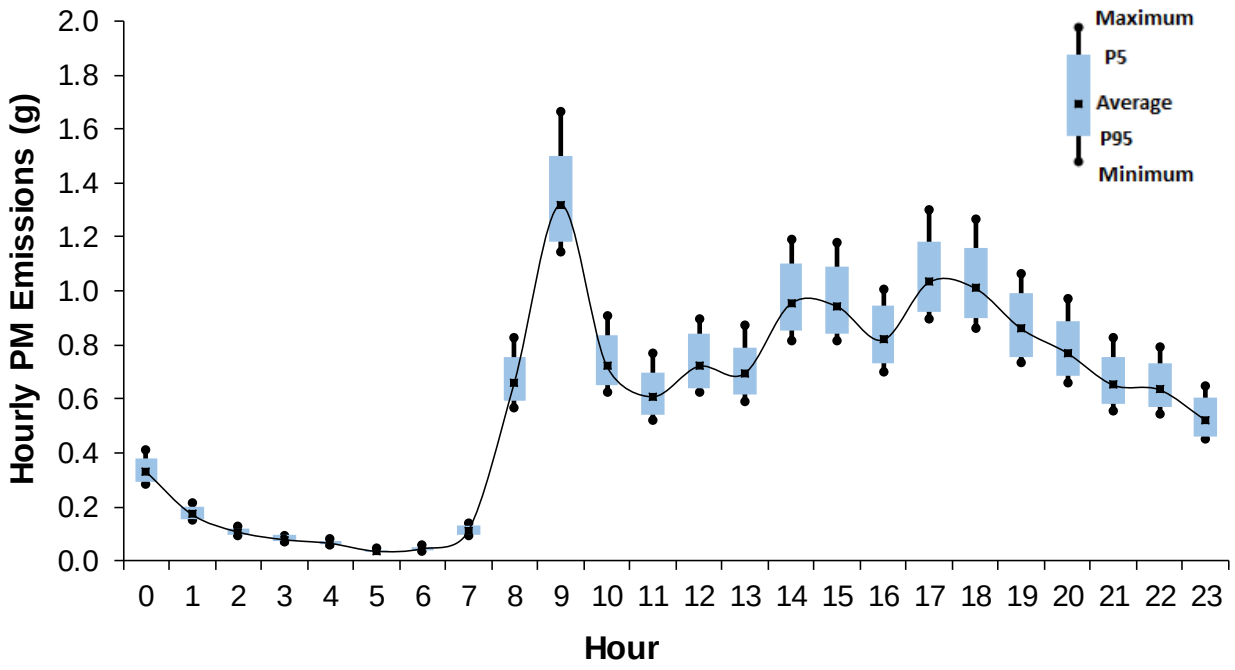
$$(+) = \left(\frac{(95th\ percentile - average)}{average}\right) \times 100$$

Uncertainty analysis: Monte Carlo approach

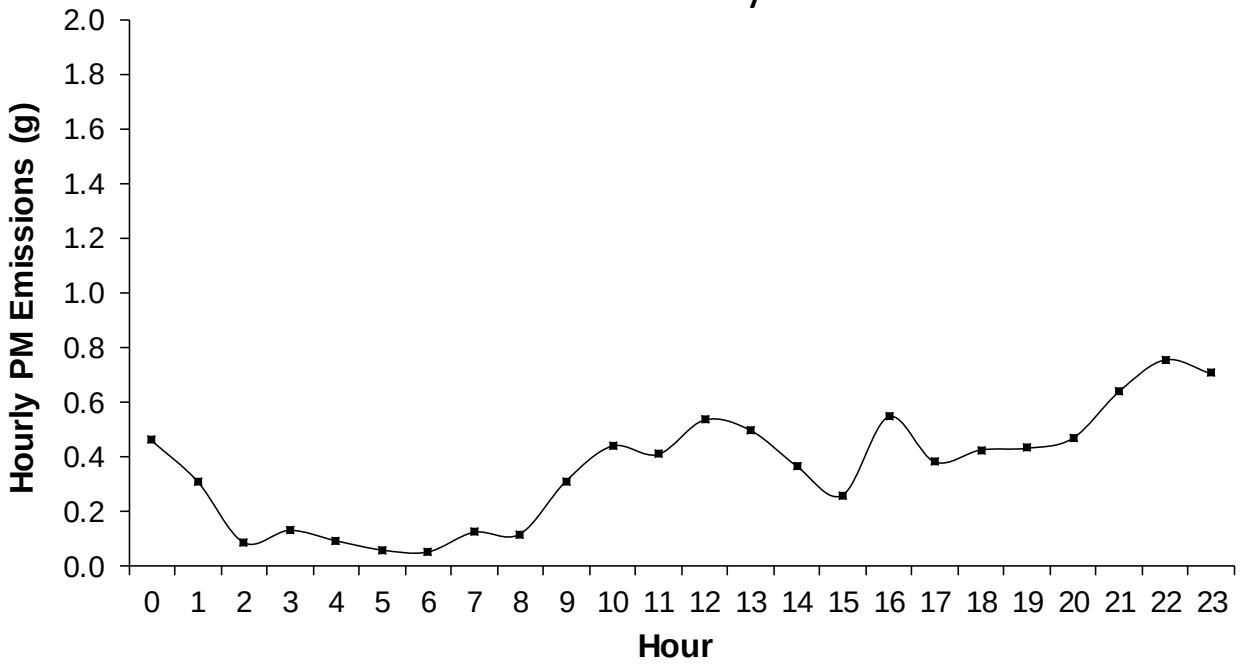
Temporal variation

Hourly $PM_{2.5}$ emissions (example for 1 road segment)

Working day



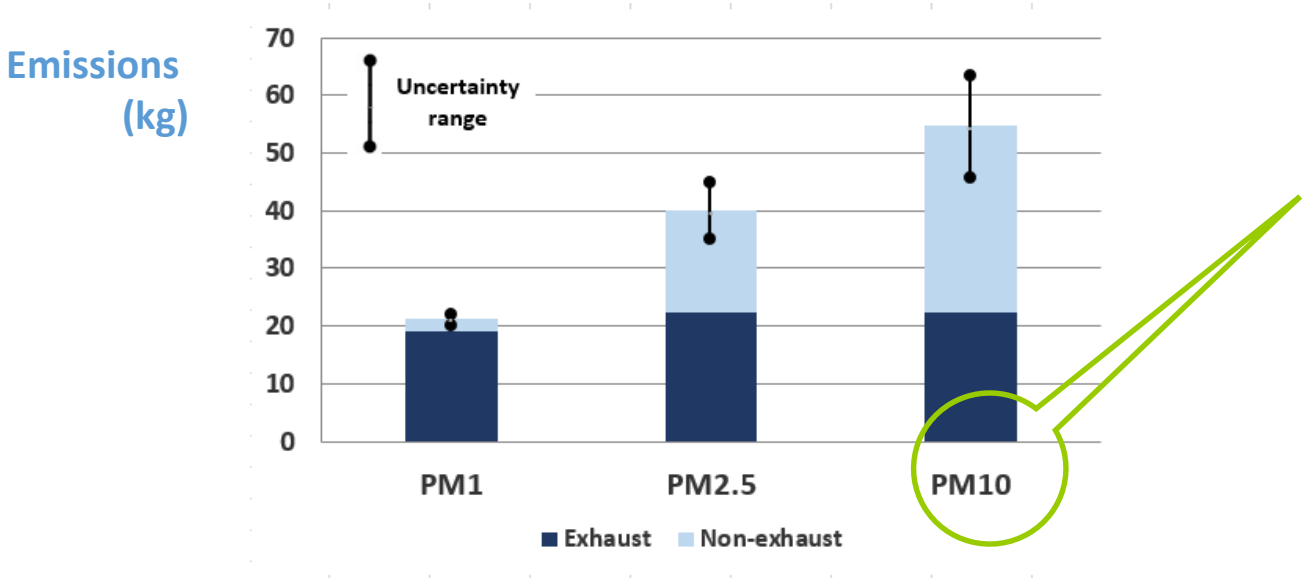
Weekend day



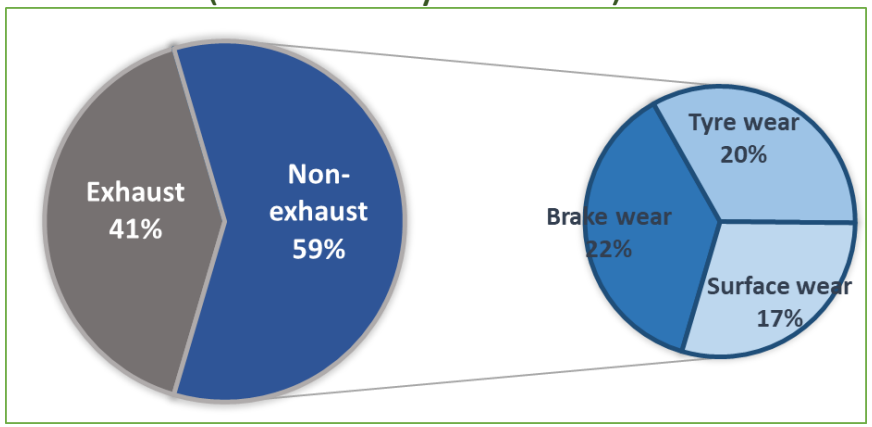
Completeness assessment

- For urban area only emissions from passenger transport are considered
- No cold-start emissions
- Non-exhaust emissions are quantified separately

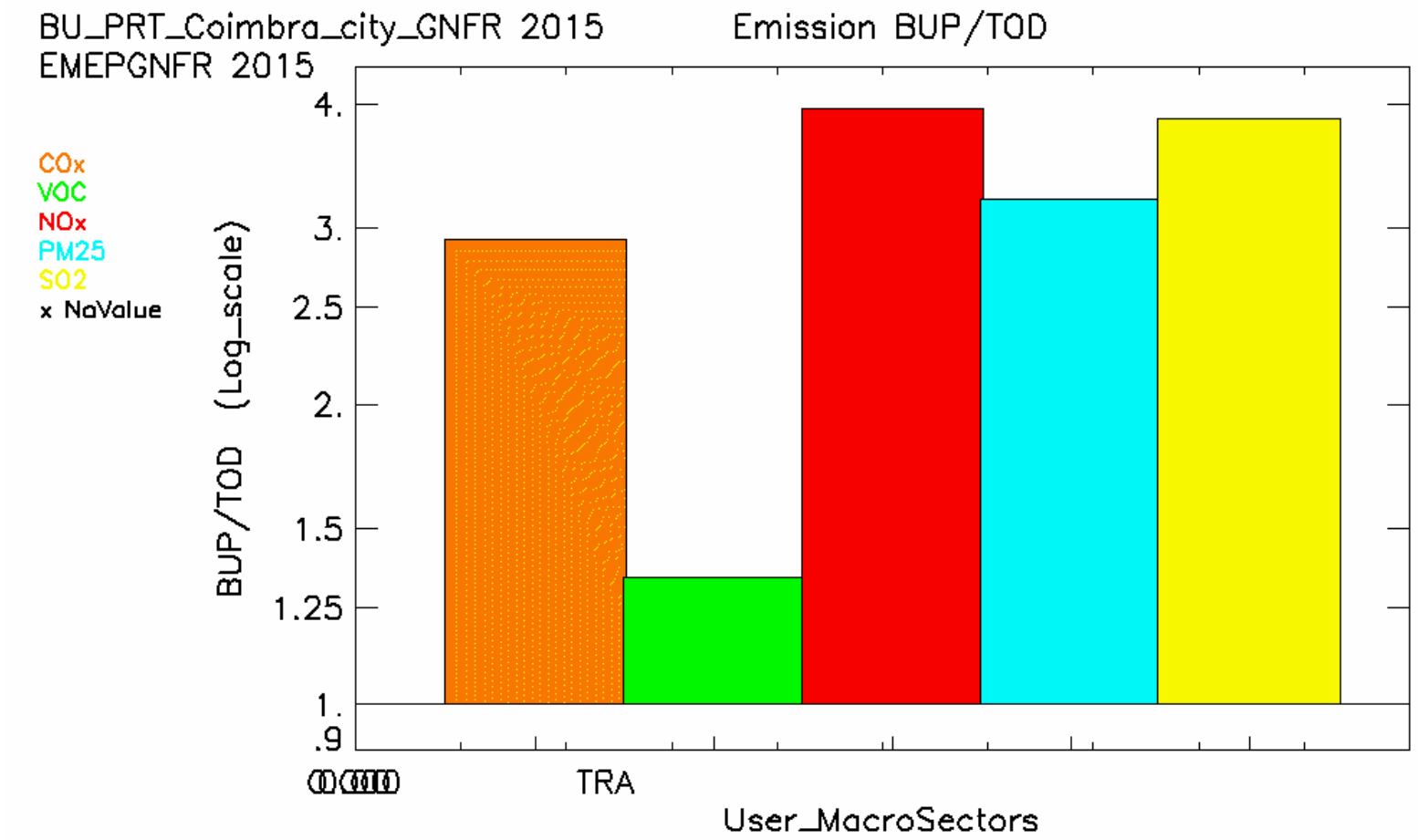
  (Is it included in TOD?)



contribution to PM10 emissions (reference year 2015)



Analysis with Delta-Tool



Analysis with Delta-Tool

What is the quality of our data?

Define the quality requirements:

select the Quality Indicators and (!) Quality Objectives

Methodology and data description

More transparency (hot, cold, non-exhaust,…)

Quality Assessment

User oriented assessment

Scientific assessment

2. Is our data fit the purpose?

Urban air quality / local authorities
Policy scenarios /measures

An example for Low Emission Zone (LEZ)

LEZ – Low Eemission Zone

LEZ implementation area:

Same as the protection zone defined for cultural heritage protection:

- University of Coimbra and Sofia

Emission criteria:

- Entry restriction applied to **private vehicles**

Euro 0	Euro 1	Euro 2	Euro 3	Euro 4	Euro 5

- Enforcement 24 hours per day. (Reference year 2011)

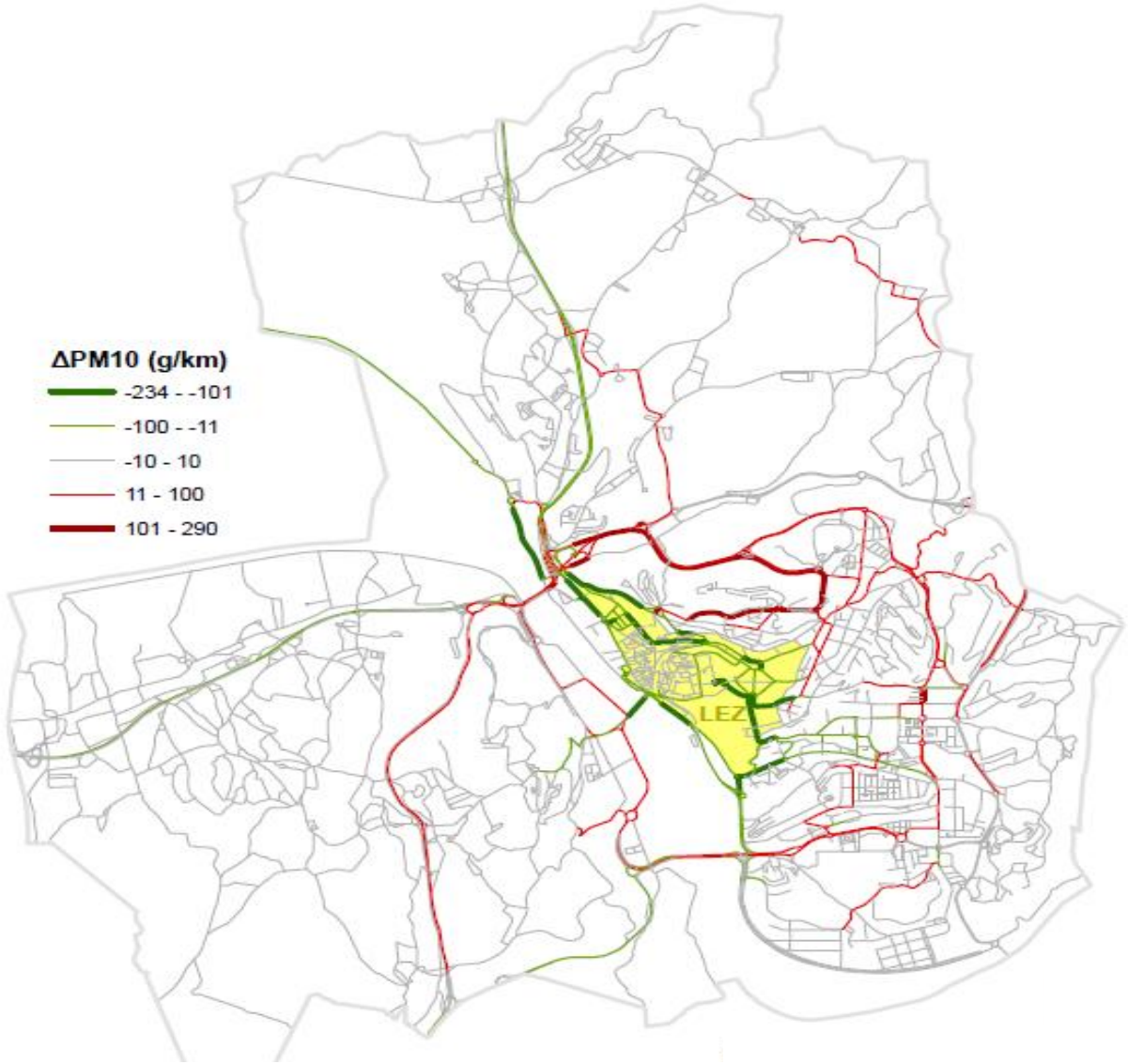
Coimbra - Unesco World Heritage

LEZ - Results

LEZ implementation - emissions:

- leads to emission **reduction inside the historic centre** of Coimbra
  - ↓ 63% for PM10
  - ↓ 52% for NO_x

- leads to a **global increase** of emissions for the urban area
  - ↑ 1.2% PM10
  - ↑ 1.5% for NOx



LEZ - Results

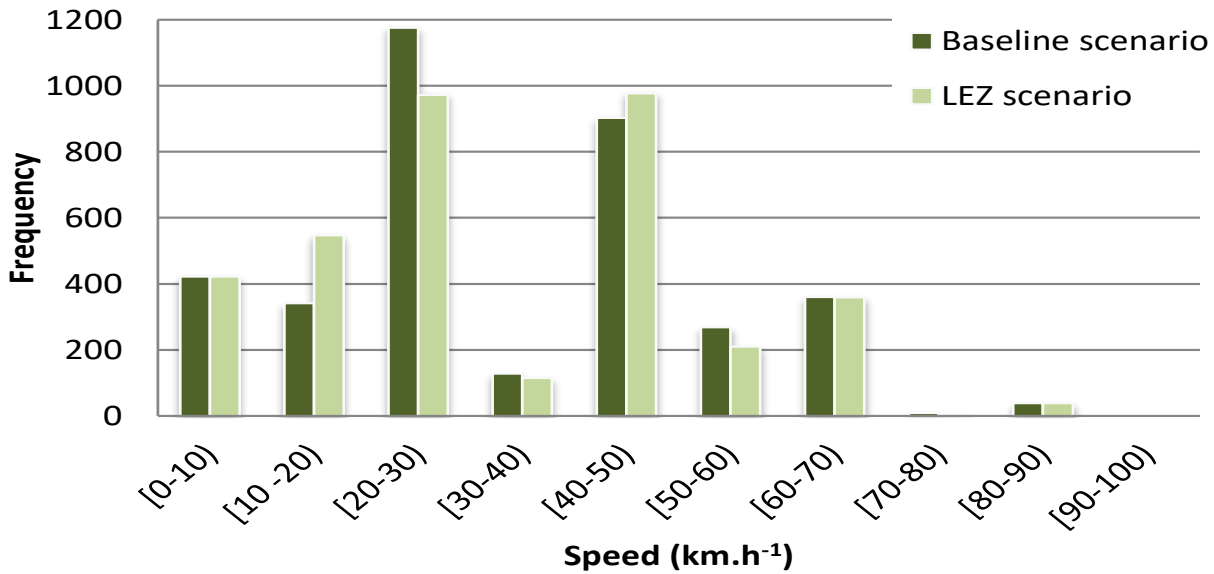
LEZ implementation - road traffic:

☑ leads to a **reduction of 27.2%** in the VKT inside the historic centre of Coimbra;

☑The most striking traffic volume decrease at road segment achieve 40.3%;

☒ VKT in Coimbra **globally increases** by 2.2%.

❑ Different frequency distribution of road-link vehicle speed for a typical working day with and without LEZ



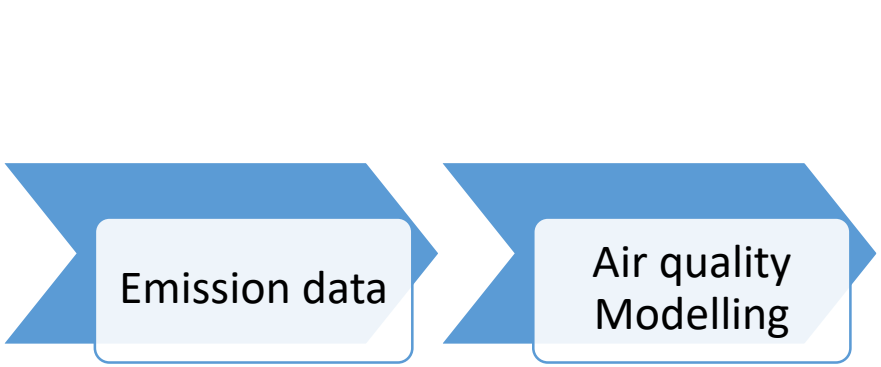
Is our data fit the purpose?

Policy scenarios /measures

- Improve technology / alternative fuels
- Shift toward more sustainable modes
- Avoid unnecessary travel and reduce trip distance
- Traffic management strategies

  - Low Emission Zone
  - Park&Ride
  - Road pricing
  - Traffic calming (20-30 km/h)
  - ….

Is our data fit the purpose?



Current AQ

AQ scenarios

Quality of the emission data is important to guarantee the validity of air quality model outputs (validation with AQ measurements) => all emission sectors, as “real” as possible

Quality of the emission data is important to guarantee comparison of different policy scenarios/alternatives (no AQ measurements!) => one emission sector, flexible approach

The same requirements for the emission data?

Final remarks

- Define the “quality”
- Define “scenarios”
- To find the answer we have to ask right question.

Start from: “How to reduce the emissions?”