FAIRMODE
Forum for air quality modelling in Europe

Technical Meeting

Athens, Greece
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WG2 Emissions

# On the road to improve the emission inventory over Portugal

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**Main goal**

to develop/build the best possible **high-resolution emission inventory for Portugal**

☑ 

SNAP2
RESIDENTIAL COMBUSTION

☑ 

SNAP3,4
INDUSTRY ACTIVITY

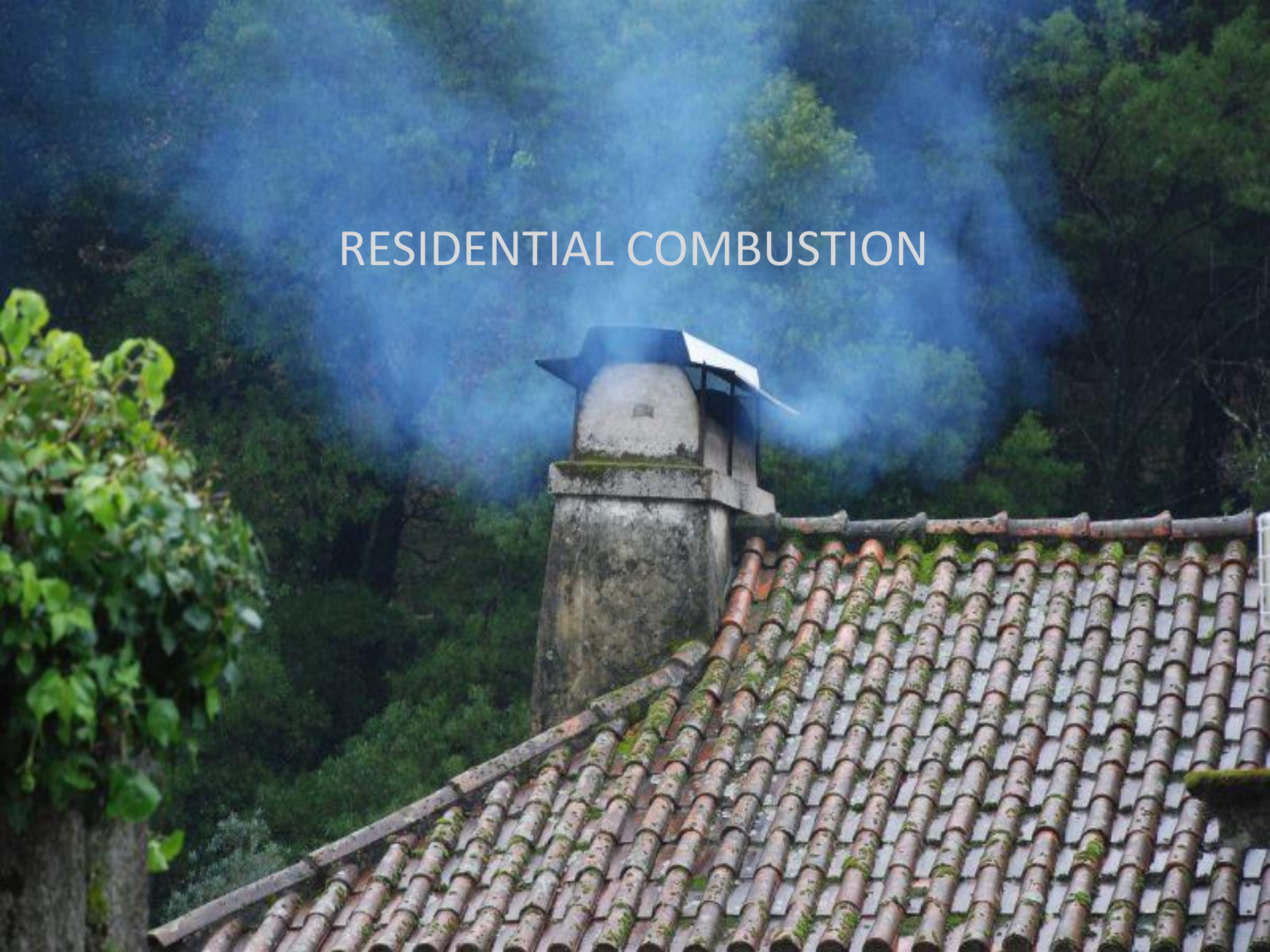
☑ 

SNAP7
ROAD TRANSPORTS

SNAP8
OTHER TRANSPORTS

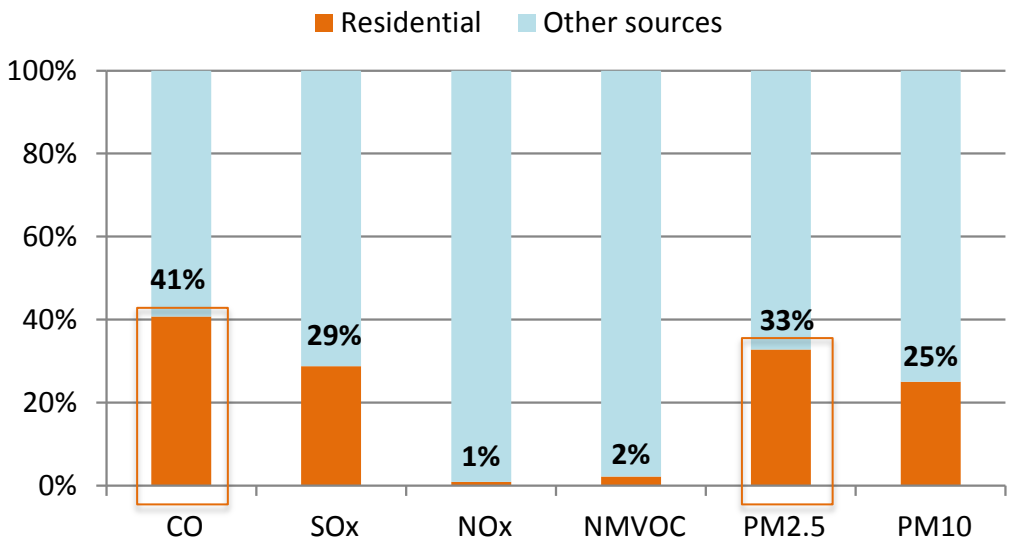
SNAP9
WASTE TREATMENT

SNAP10
AGRICULTURE

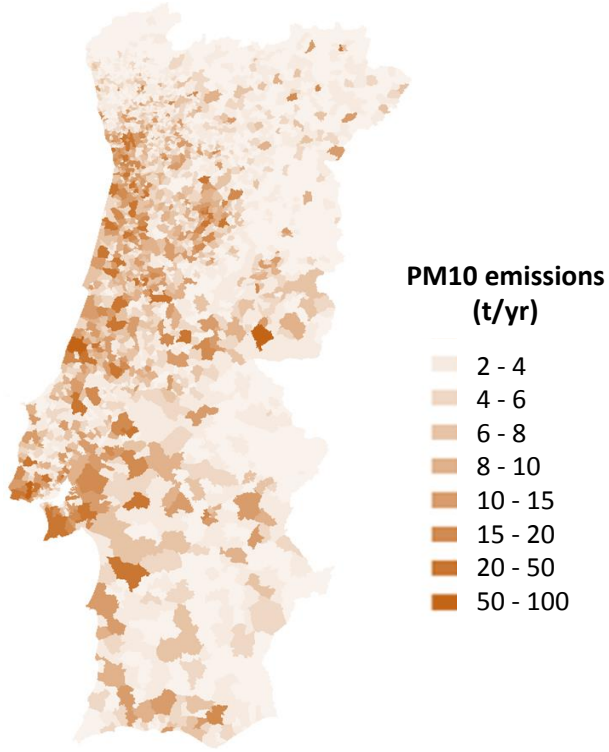

RESIDENTIAL COMBUSTION

# Residential Combustion

## National totals



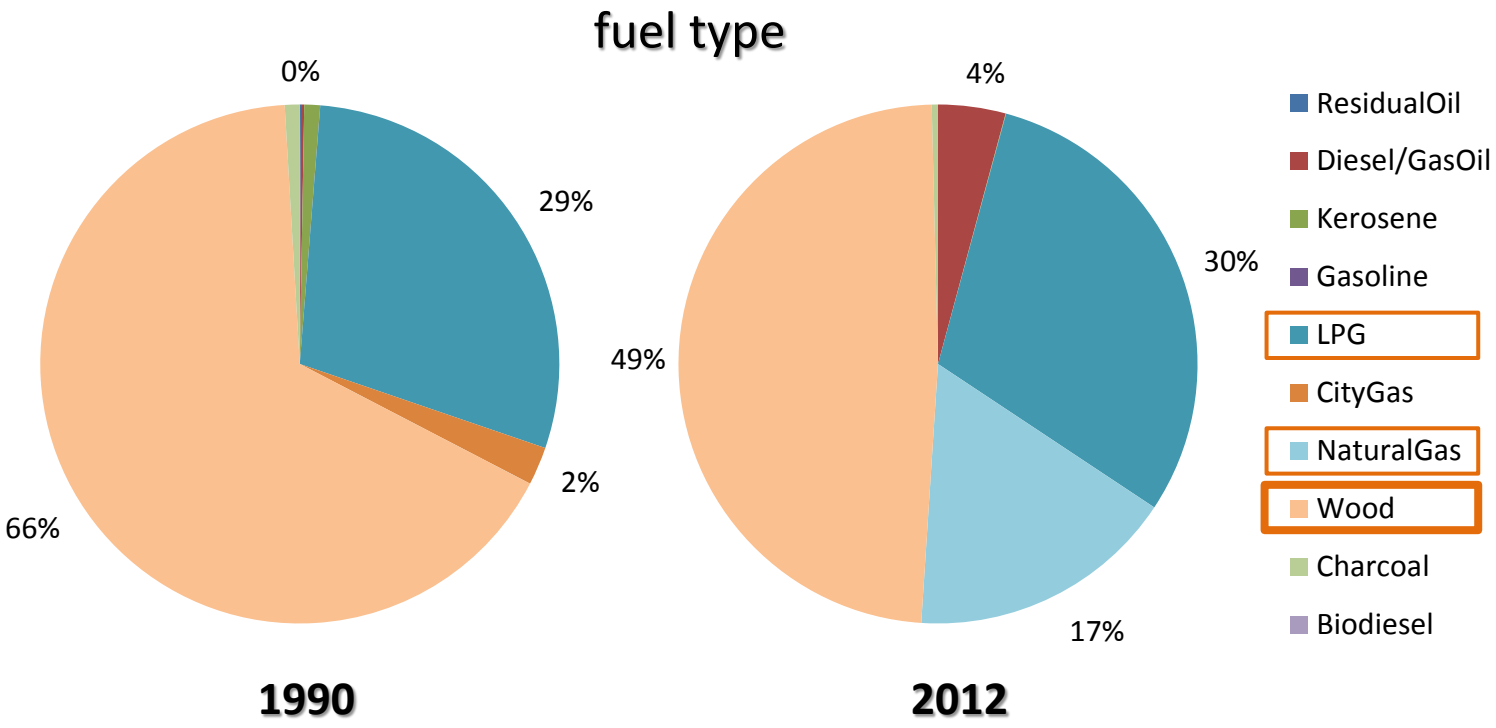

## Spatial distribution (population density)



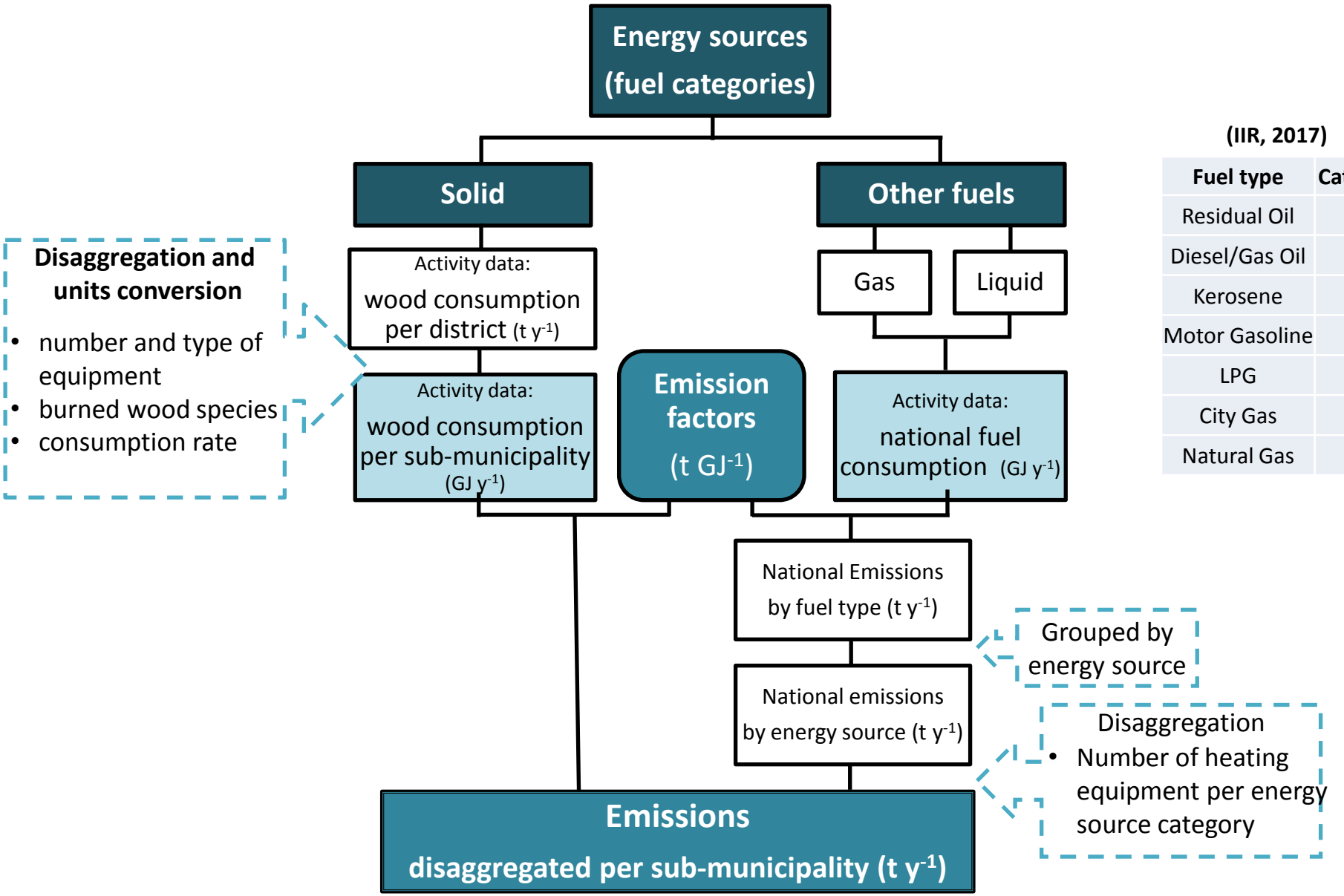

(2012 year)

# Residential Combustion

## Energy consumption



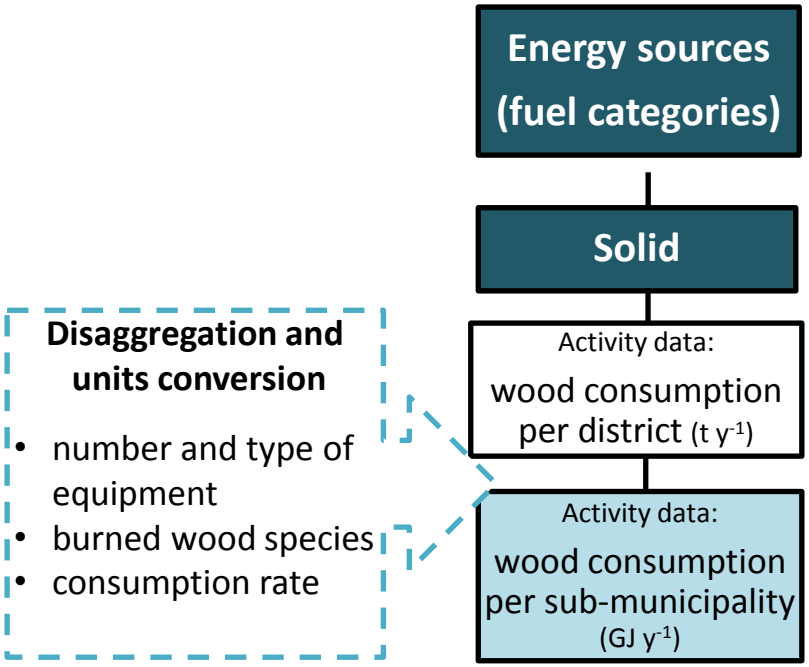
# New approach | methodology



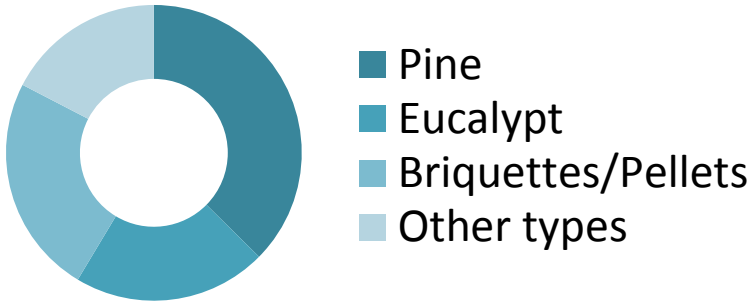

(IIR, 2017)

| Fuel type | Category |
|---|---|
| Residual Oil | Liq |
| Diesel/Gas Oil | Liq |
| Kerosene | Liq |
| Motor Gasoline | Liq |
| LPG | Liq |
| City Gas | Liq |
| Natural Gas | Gas |

# New approach | methodology




**Wood species consumed in Portugal** (DGEG, 2011)




**Consumption rate** per equipment and wood species (Calvo et al., 2014)

| | |
|---|---|
| Fireplaces | 61% |
| Woodstoves | 23% |

pine: 1,8 ± 0,07 kg.h$^{-1}$
eucalypt: 1,9 ± 0,2 kg.h$^{-1}$

pine: 2,1 ± 0,1 kg.h$^{-1}$
eucalypt: 2,0 ± 0,2 kg.h$^{-1}$

# Emission factors

For **wood species**

| Pollutant | Wood species | Equipment | | Reference |
|---|---|---|---|---|
| | | Fireplace | Woodstove | |
| PM2.5 | Pine | 372.97 | 281.08 | Gonçalves et al., 2012 |
| | Eucalypt | 648.65 | 540.54 | Gonçalves et al., 2012 |
| | Briquettes/Pellets | 648.65 | 383.78 | Gonçalves et al., 2012 |
| PM10 | Pine | 722.42 | 256.09 | Duarte, 2011 |
| | Eucalypt | 1093.70 | 411.50 | Duarte, 2011 |
| | Briquettes/Pellets | --- | --- | --- |
| CO | Pine | 2762.16 | 3086.49 | Gonçalves et al., 2012 |
| | Eucalypt | 4264.86 | 3654.05 | Gonçalves et al., 2012 |
| | Briquettes/Pellets | 3151.35 | 3400 | Gonçalves et al., 2012 |

EF units - mg/MJ

# Emission factors

For **liquid, gaseous and other solid fuels**

| Fuel | Type | Emission factors (mg/MJ) | | | | | |
|---|---|---|---|---|---|---|---|
| | | PM2.5 | PM10 | NOx | $SO_2$ (%S) | NMVOC | CO |
| Residual Oil | Liquid | 1.90 | 1.90 | 51 | 1.00 | 1.00 | 57 |
| Diesel/Gas Oil | Liquid | 1.90 | 1.90 | 69 | 0.01 | 0.20 | 4 |
| Kerosene | Liquid | 1.90 | 1.90 | 51 | 0.15 | 0.70 | 57 |
| Motor Gasoline | Liquid | 1.90 | 1.90 | 51 | 0.015 | 0.70 | 57 |
| LPG | Liquid | 0.90 | 0.90 | 48 | 0.0016 | 1.90 | 25 |
| City Gas | Liquid | 0.90 | 0.90 | 48 | 0.0 | 1.90 | 25 |
| Natural Gas | Gas | 0.90 | 0.90 | 48 | 0.0007 | 1.90 | 25 |
| Wood | Solid | 494 | 504 | 73 | 0.03 | 410 | 4000 |
| Charcoal | Solid | 818 | 839 | 73 | 0.03 | 410 | 4000 |
| Biodiesel | Solid | 2 | 2 | 69 | 0.0 | 0.20 | 4 |

Source: PT IIR, 2017

# Results | new *vs* old approach

| Approach | Total emission in PT (t/yr) | | | | | |
|---|---|---|---|---|---|---|
| | PM2.5 | PM10 | NOx | SOx | NMVOC | CO |
| **Old** (pop disag) | 15 700 | 16 100 | 4 000 | **1 500** | 13 100 | **127 800** |
| **New** (calculated) | **17 015** | **20 667** | **4 209** | 1 201 | **14 448** | 123 809 |

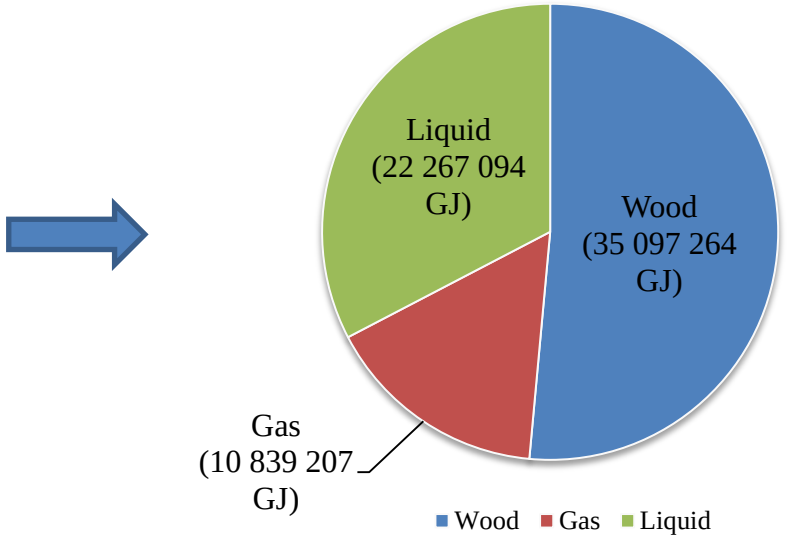
**Old** (disaggregated by population)
**New** (recalculated)

# Results | new approach

Contribution by fuel category for the total emission (%)

| Fuel | Total emission in PT (%) | | | | | |
|---|---|---|---|---|---|---|
| | PM2.5 | PM10 | NOx | SOx | NMVOC | CO |
| **Wood** | **99.8** | **99.8** | **60.9** | **97.4** | **99.6** | **99.4** |
| Gas | 0.1 | 0.0 | 12.4 | 0.3 | 0.1 | 0.2 |
| Liquid | 0.1 | 0.1 | 26.8 | 2.3 | 0.3 | 0.4 |

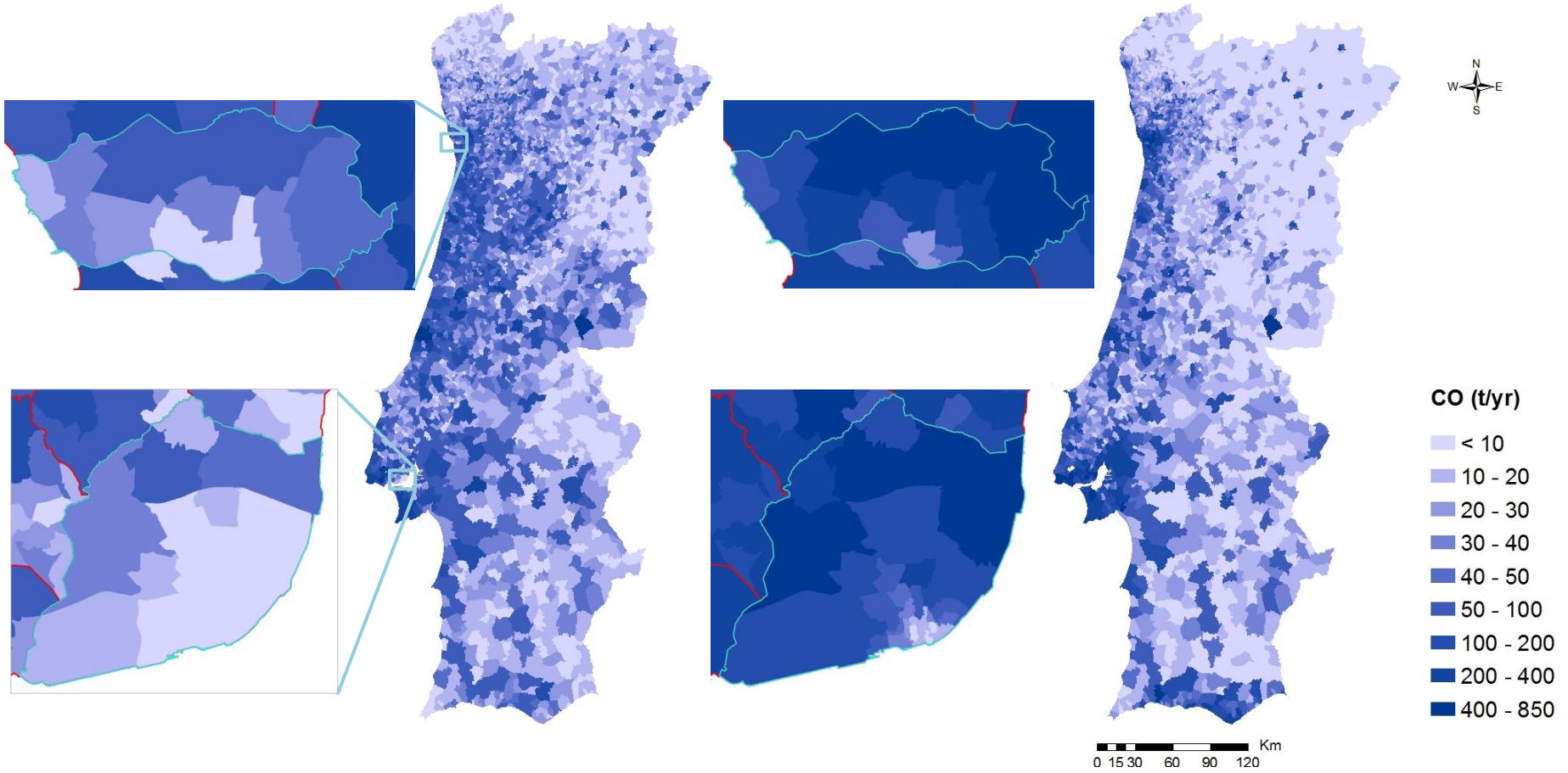
Total fuel consumption (GJ) per fuel category



# Results | CO emissions

**New** approach
(recalculated)

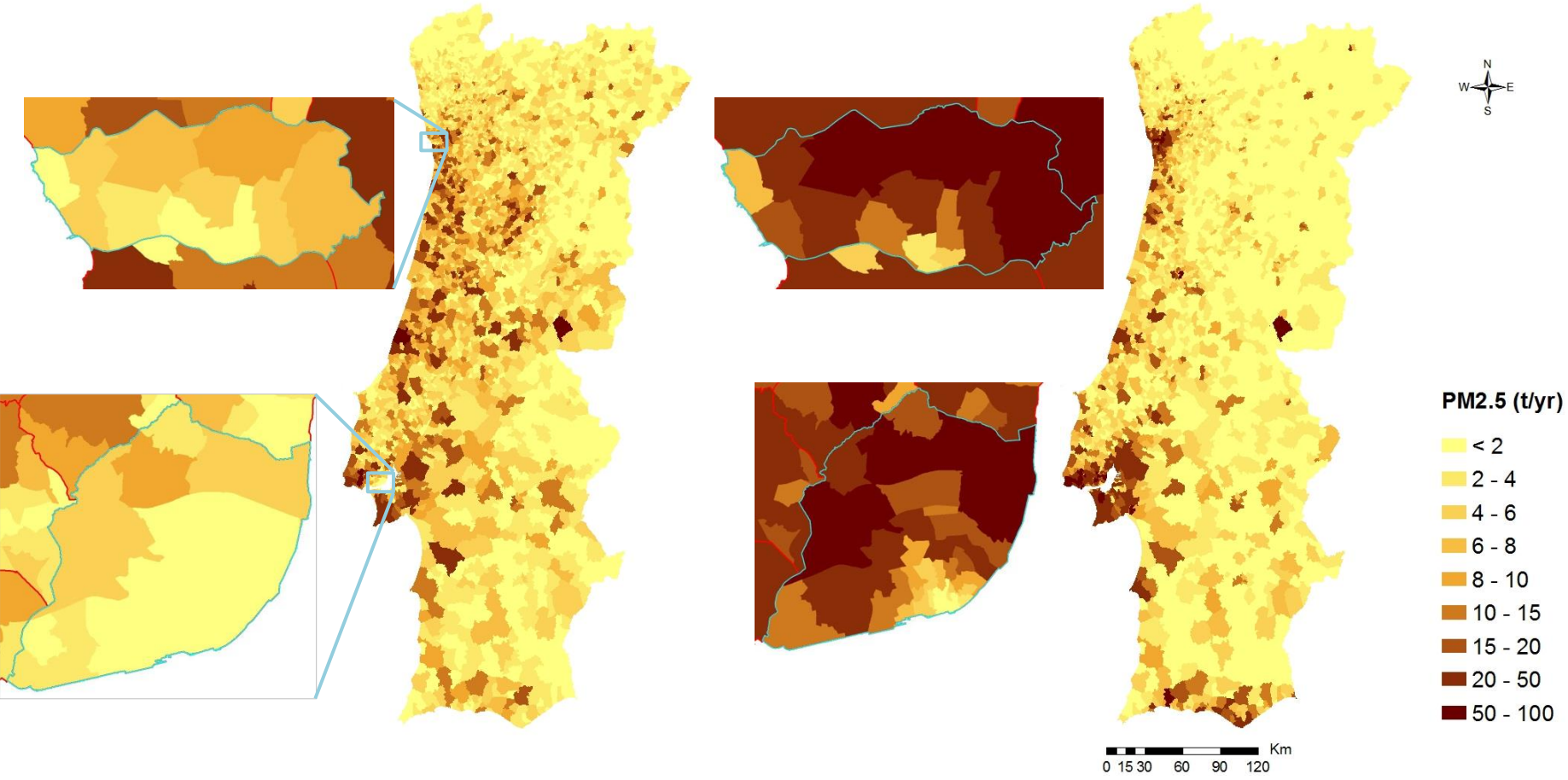
**Old** approach
(disaggregated by population)



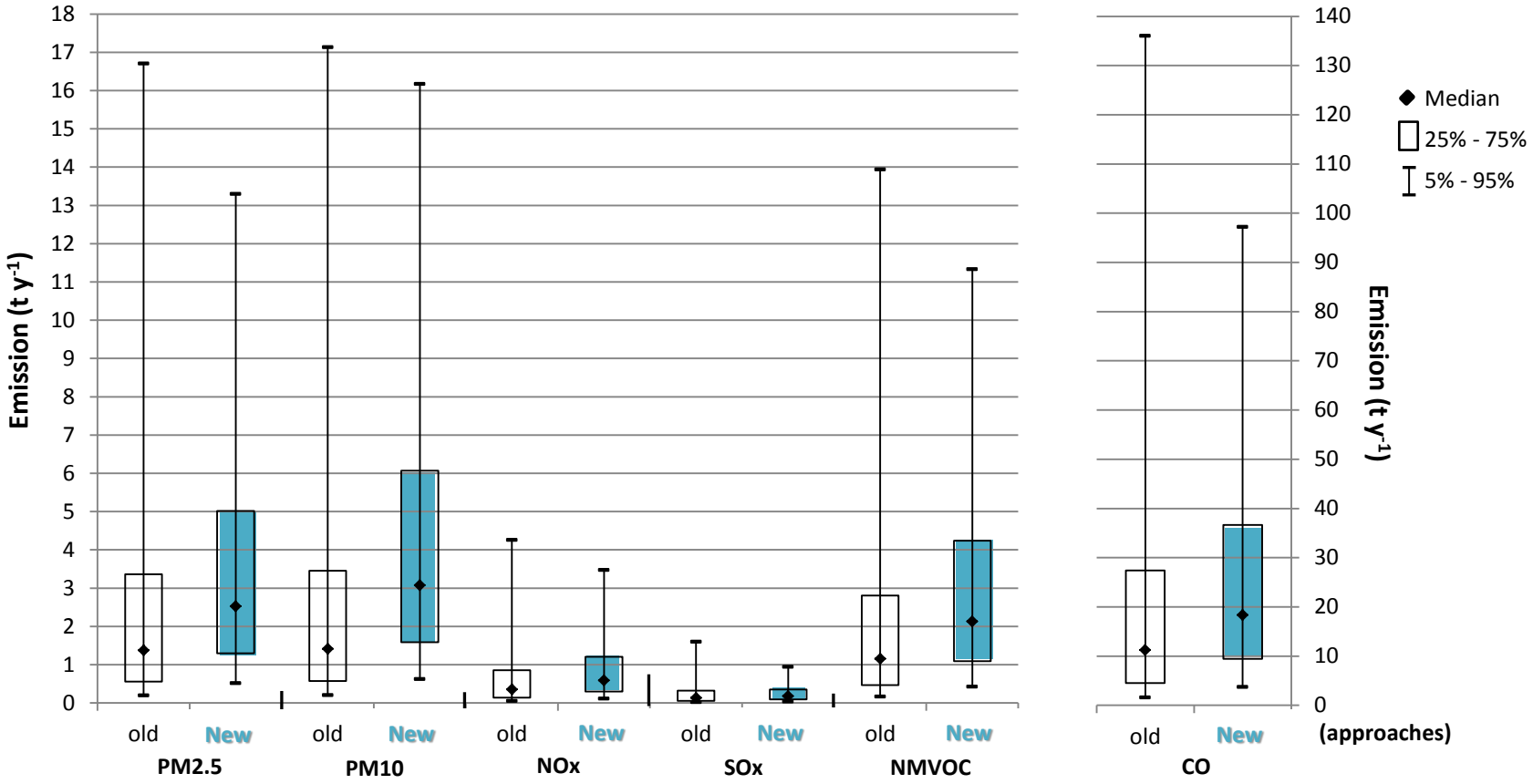
# Results |PM2.5 emissions

**New** approach
(recalculated)

**Old** approach
(disaggregated by population)

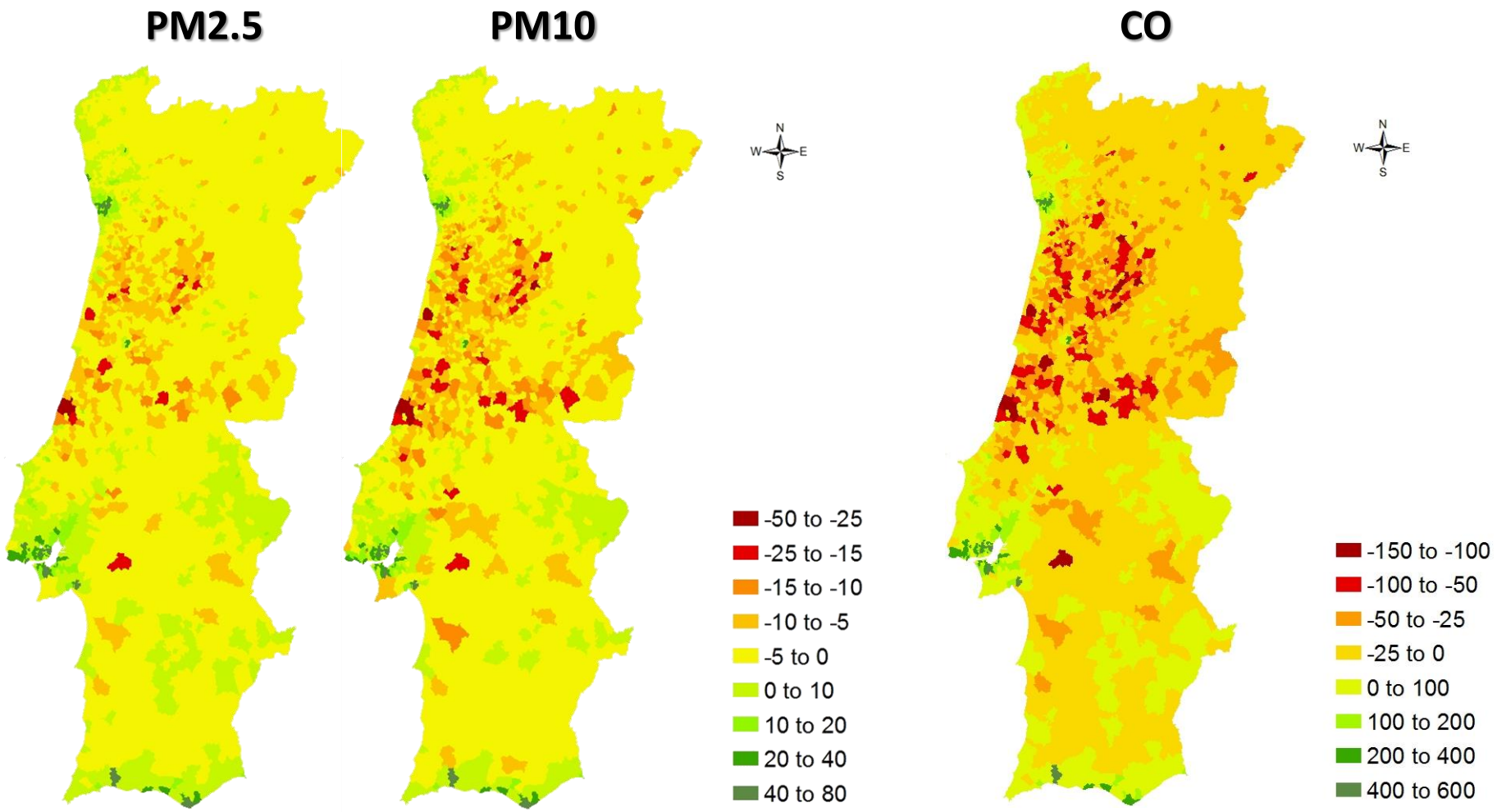


# Results |all pollutants




**New approach:** lower maxima (P95)
lower minima (P5)
smaller ranges of values

# Results | % differences (old-new)




TRANSPORTS

# Line sources | metodology

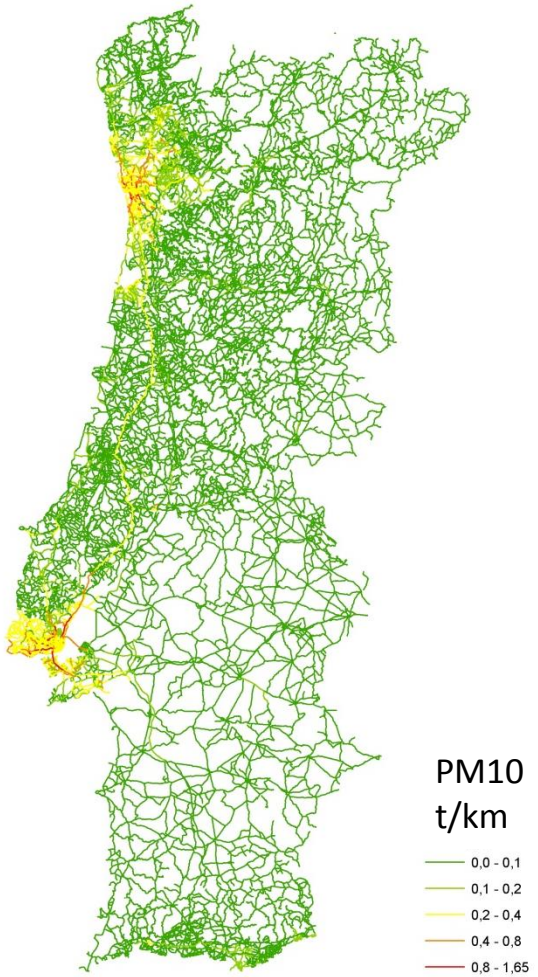
**Input data**
Road transport national total emissions (2012 year)
TREM model output

**Method:**

1. Using **TREM** emission model to calculate the emissions per road segment (with available data for vehicles counting)
2. Calculating the **difference** between the total national emissions and the emissions estimated as lines sources (step 1)
3. **Disaggregating** the difference per municipality and population
4. Inside each municipality, the disaggregation was done considering the different importance/weight of each type of route:

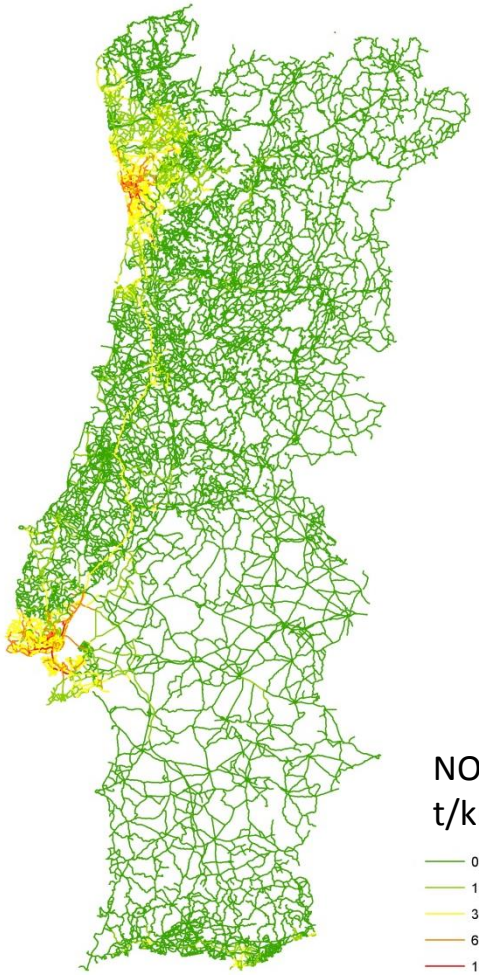
   motorway- 2
   trunk- 1.8
   primary- 1
   secondary- 0.7
   tertiary- 0.55

# Road transport emissions
# Line sources



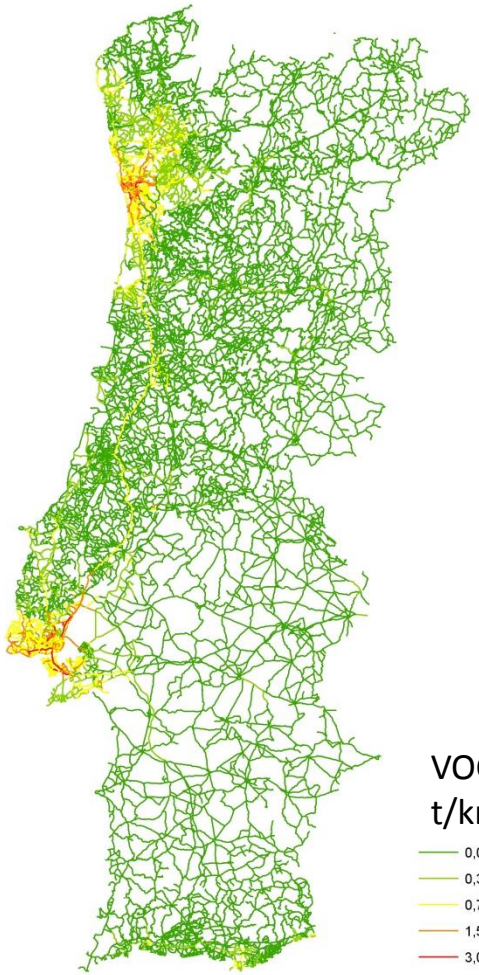
PM10
t/km

- 0,0 - 0,1
- 0,1 - 0,2
- 0,2 - 0,4
- 0,4 - 0,8
- 0,8 - 1,65



$NO_2$
t/km

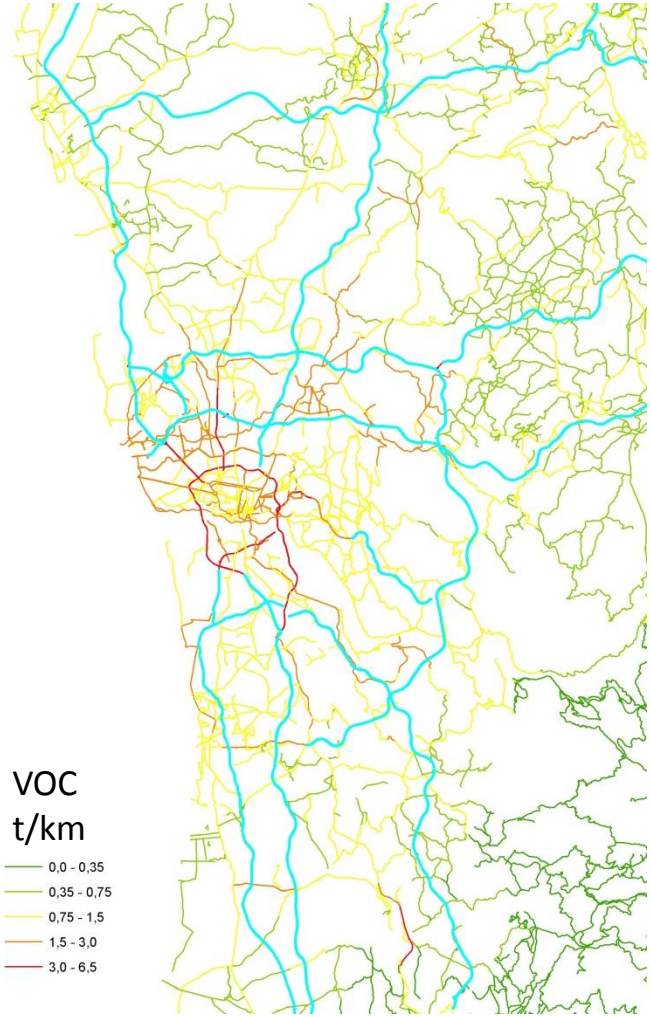
- 0,0 - 1,5
- 1,5 - 3
- 3 - 6
- 6 - 12
- 12 - 24

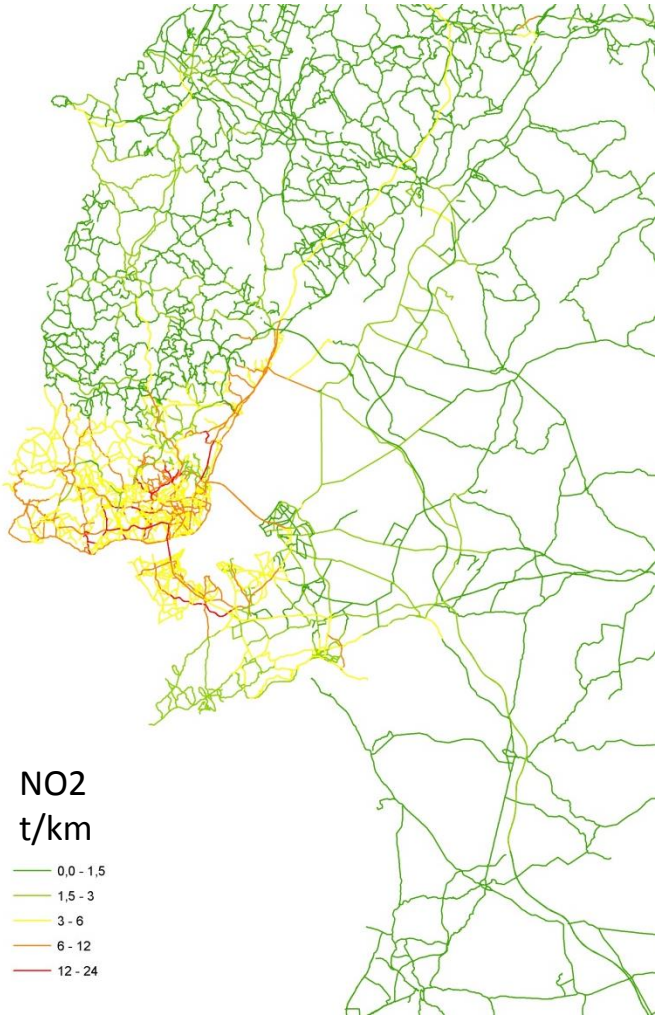


VOC
t/km

- 0,0 - 0,35
- 0,35 - 0,75
- 0,75 - 1,5
- 1,5 - 3,0
- 3,0 - 6,5

# Zoom over Porto & Lisbon

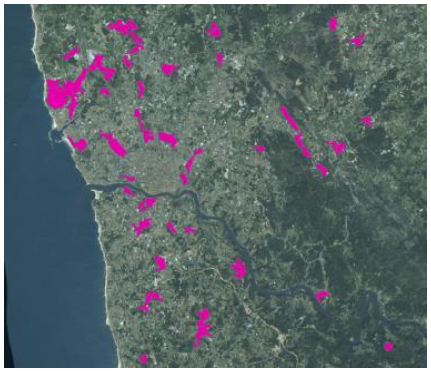


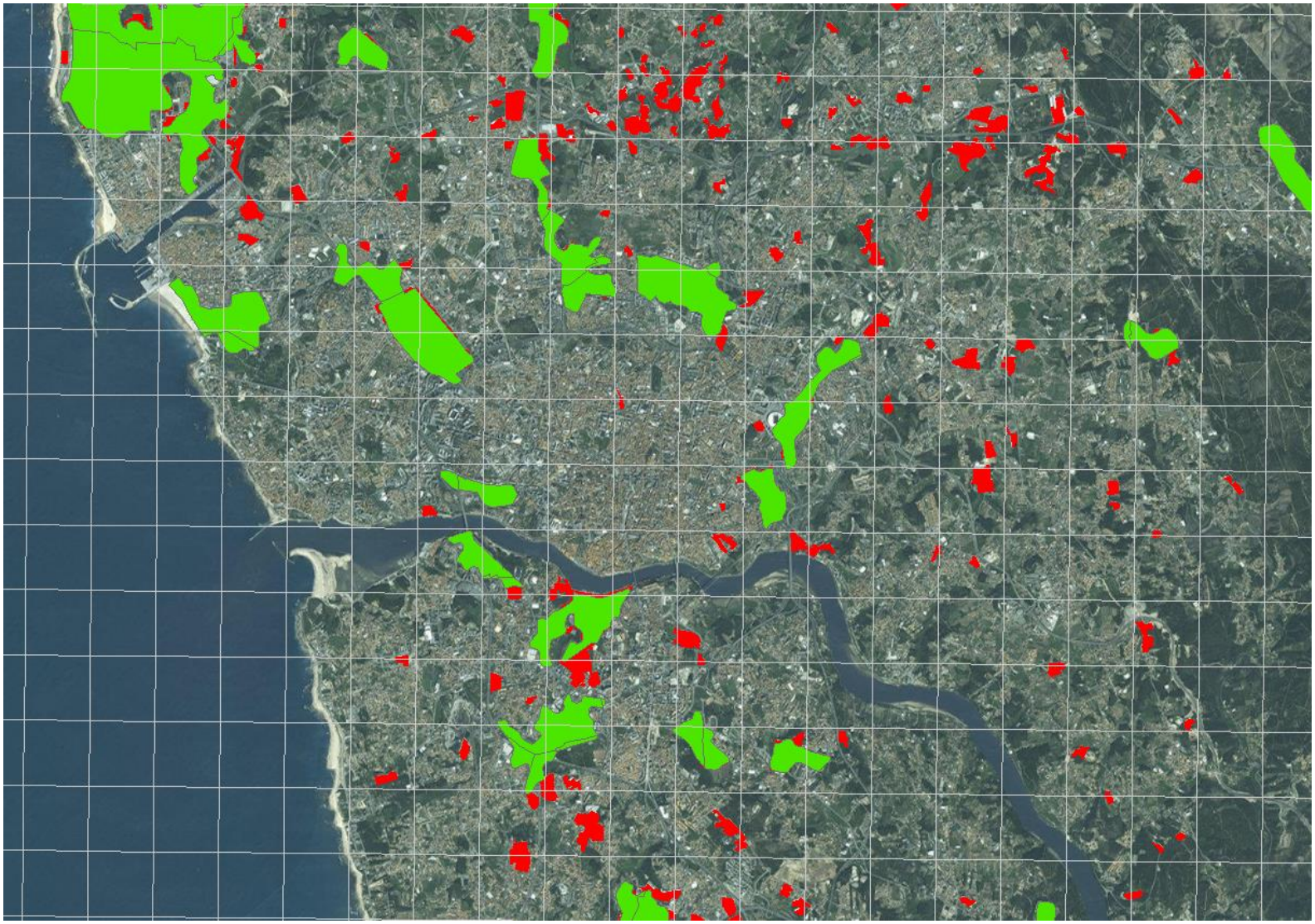



# INDUSTRIAL PROCESSES & COMBUSTION

# Methodology

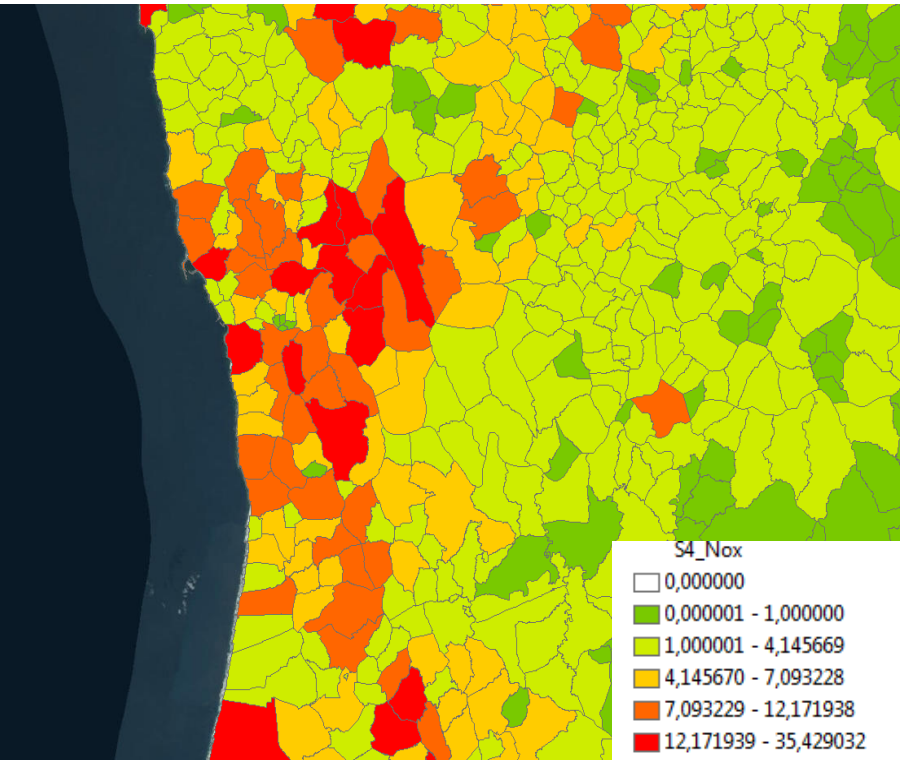
Emissions by municipality → ~~CORINE Land Cover~~ National Landcover → Ponderation by area → Final emissions



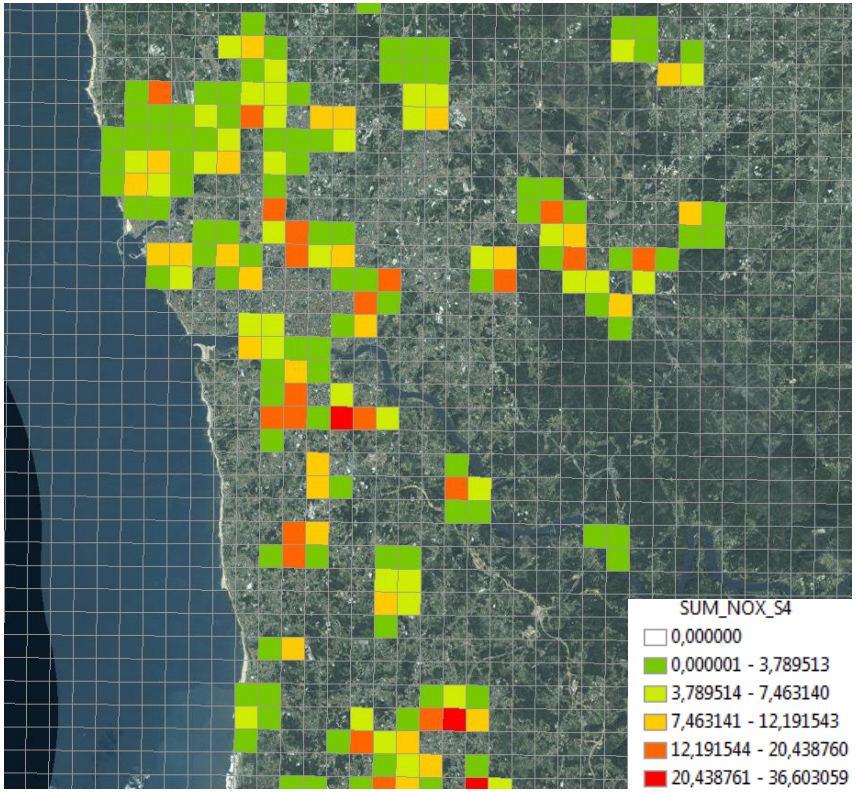

CORINE Land Cover (commercial/industrial activities)
National Land Cover

# Emissions SNAP 4 (ton/year)

CORINE Landcover




National Landcover




(1x1 km$^2$)

Now…

let’s know hope that these improvements on the emission data will be traduced in less uncertainty on air quality results!