

FAIRMODE CT8: Analysis of the spatial representativeness of air quality stations in Europe using EMEP/uEMEP

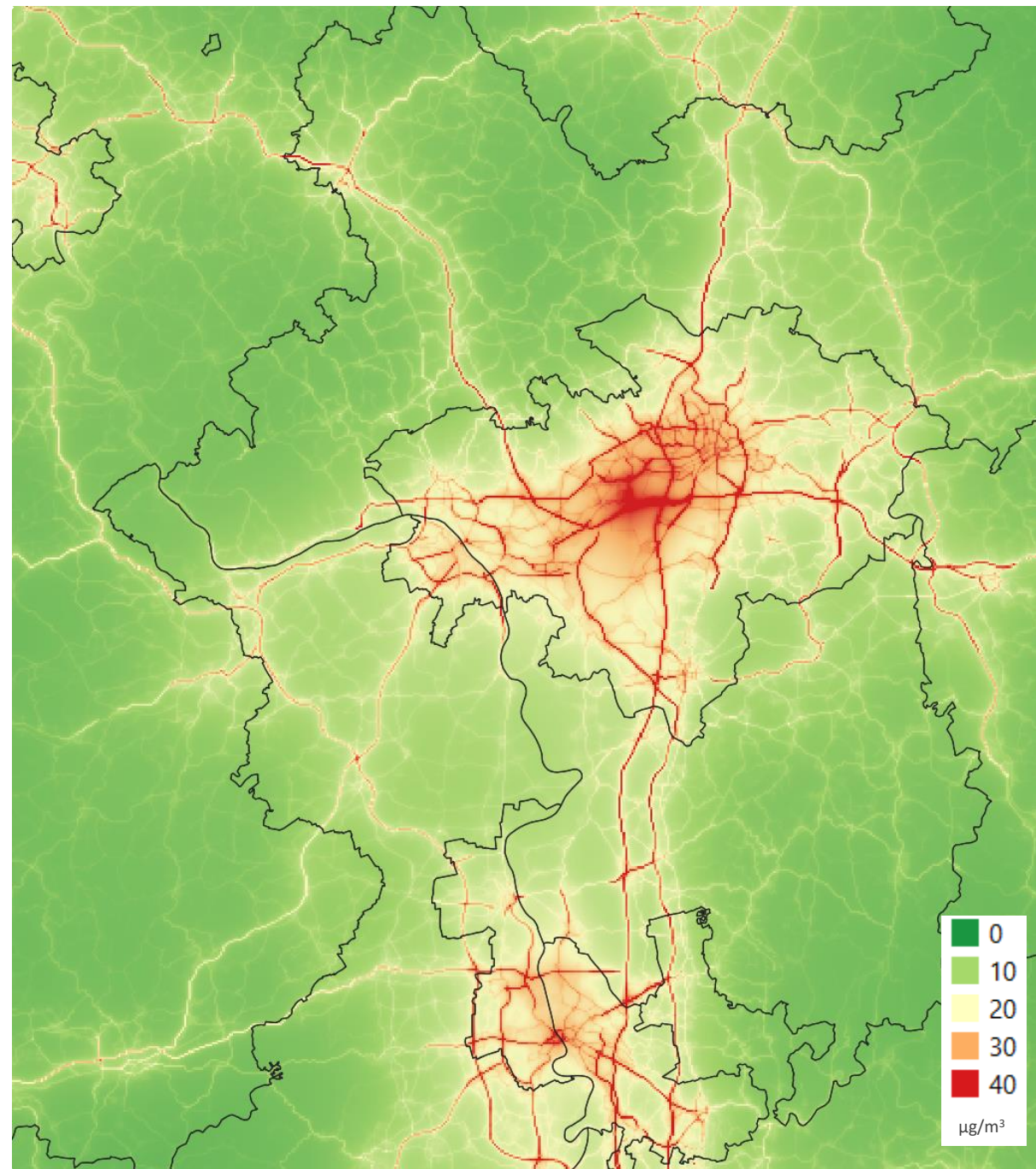
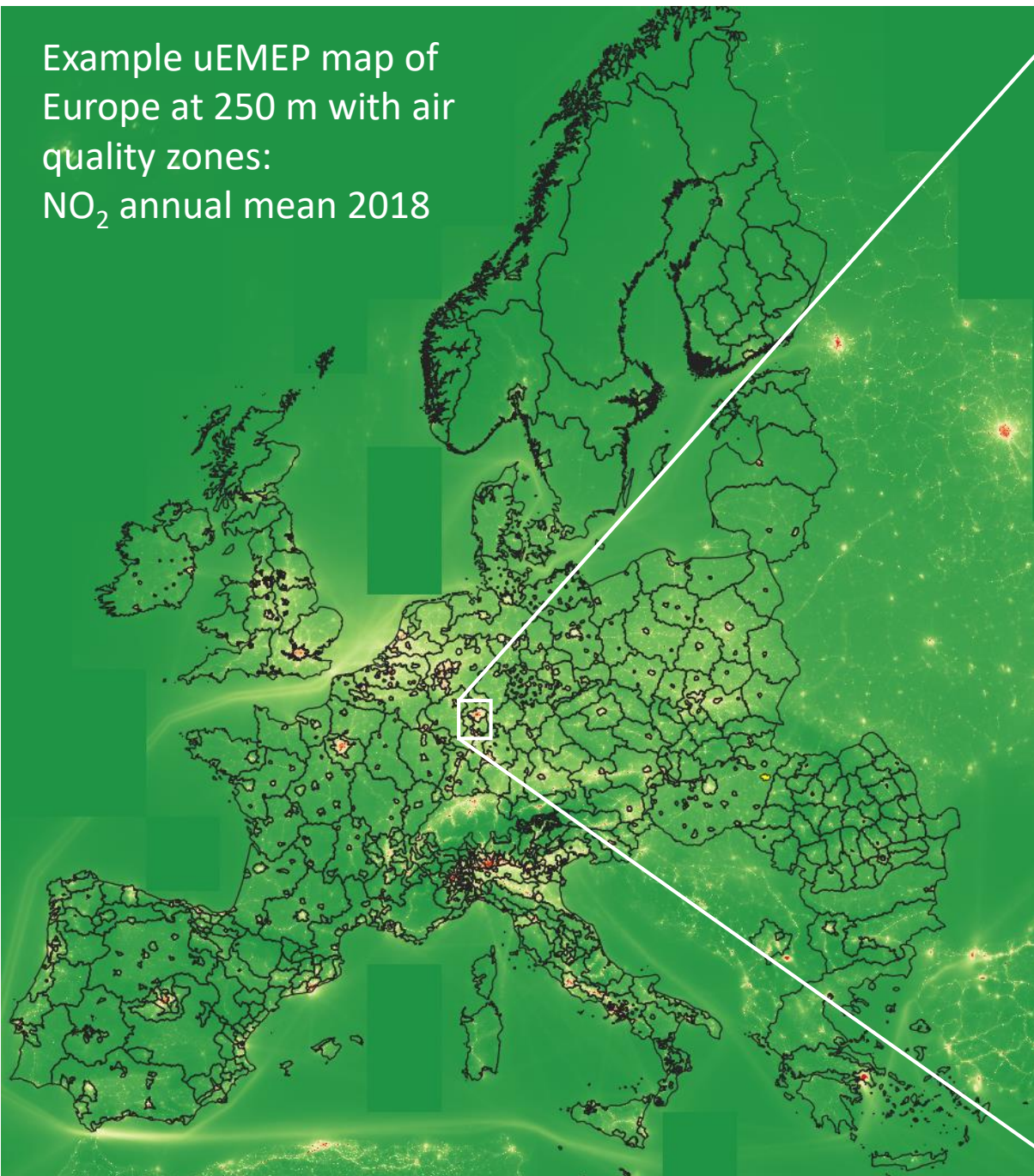
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Meteorologisk
institutt

Example uEMEP map of Europe at 250 m with air quality zones:
NO₂ annual mean 2018



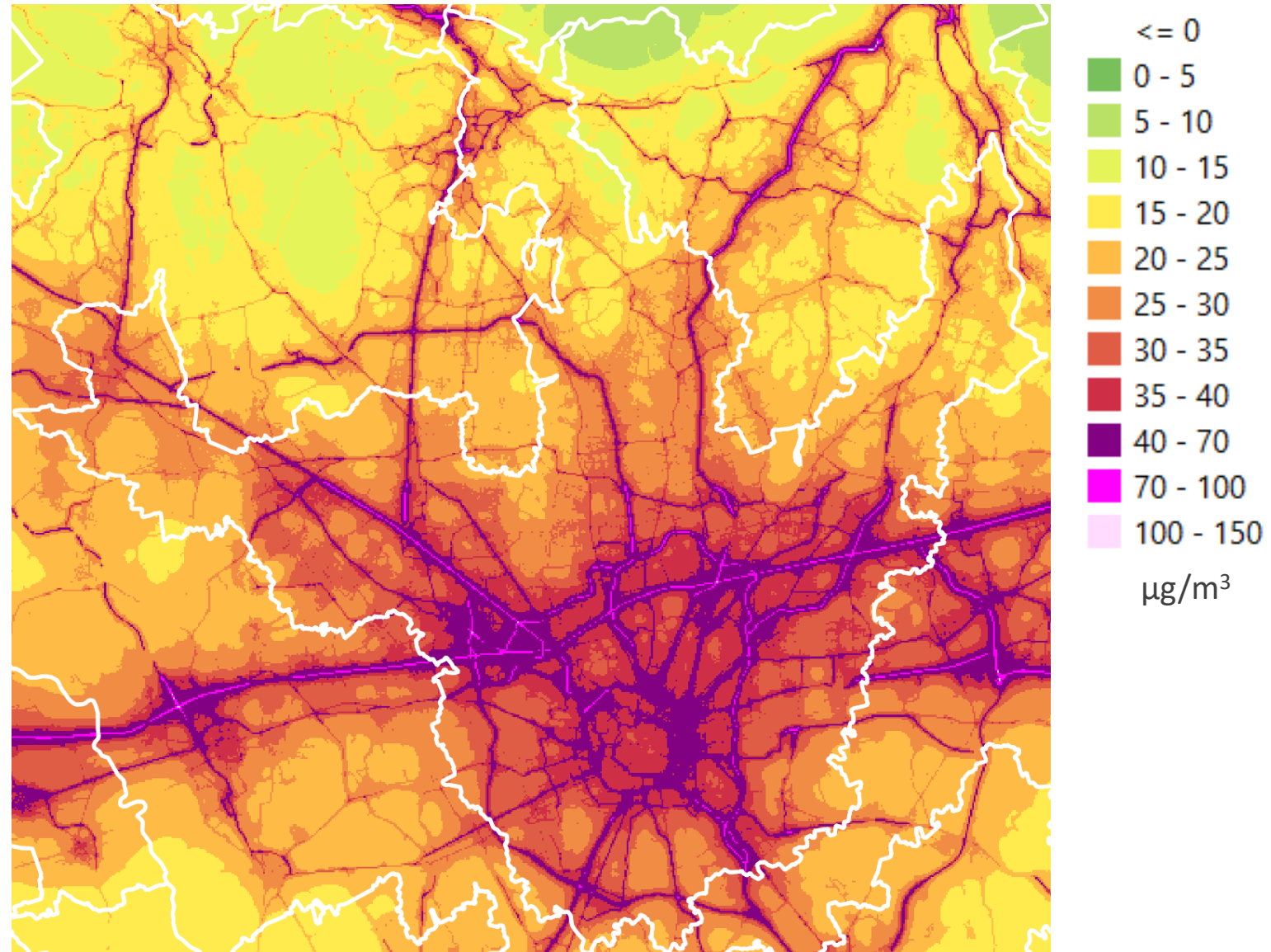
Overview

- EMEP/uEMEP has been applied at 100 m for all of Europe (2018) to assess the Spatial Representativeness Area (SRA) of Airbase stations for annual mean concentrations of:
 - NO₂, PM_{2.5}, PM₁₀ and O₃
- The SRA has been assessed for every Airbase station in Europe:
 - Using concentration threshold criteria of $\pm 20\%$, $\pm 10\%$ and $\pm 5\%$
 - The SRA is bounded by the air quality zone perimeter
 - No absolute threshold value is imposed
- Results are presented as histograms of SRA in km² and summarized using the median of the distribution for the different station classifications:
 - all stations
 - (sub)urban background
 - rural background
 - traffic
- Scatter plots are also provided for validation purposes

Example maps from the Milan air quality zone

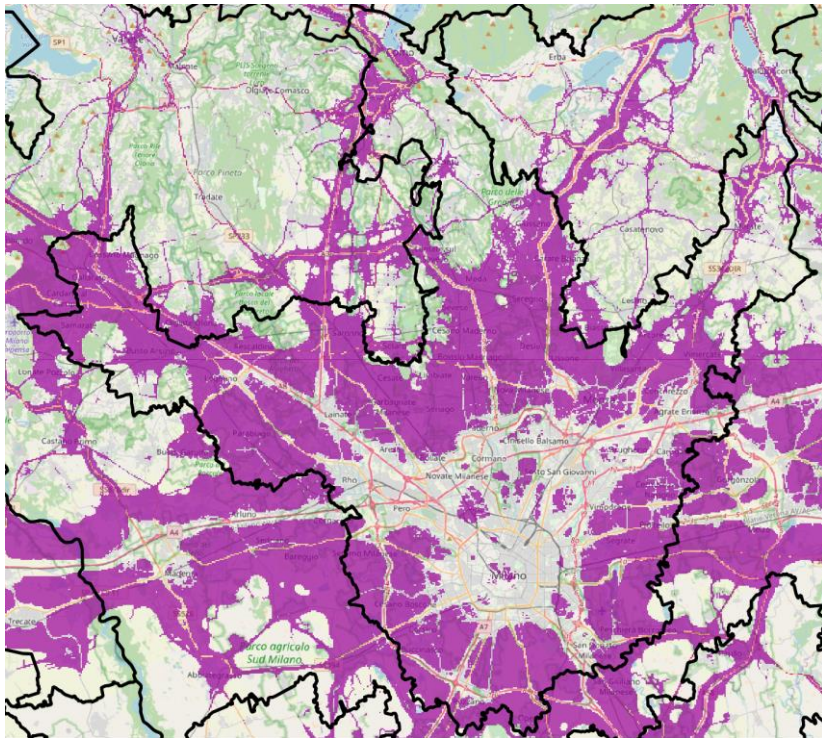
100 m resolution concentrations NO_2

Example from
the Milan AQ
zone

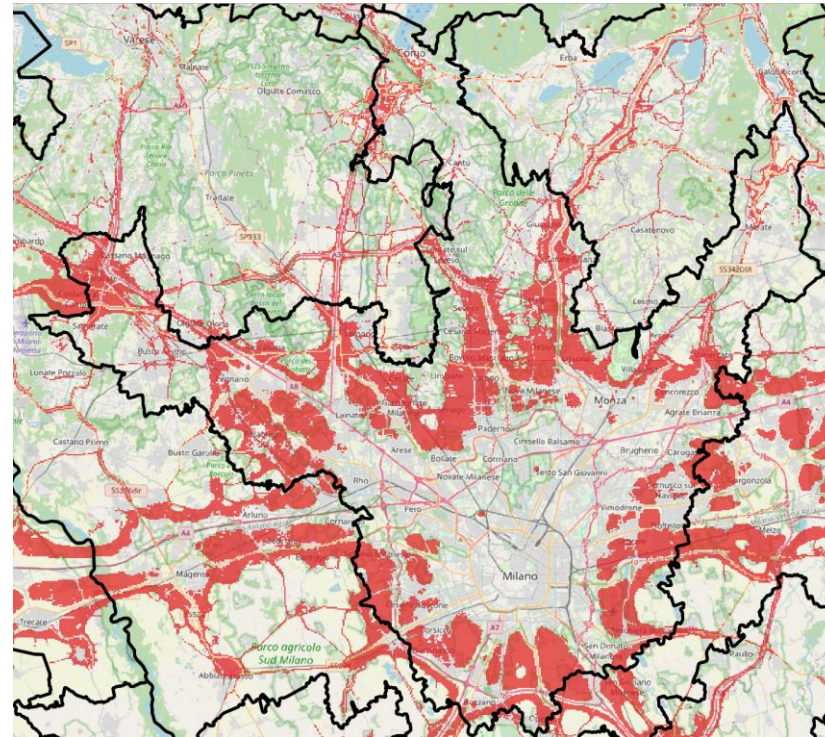


100 m resolution spatial representativeness NO₂

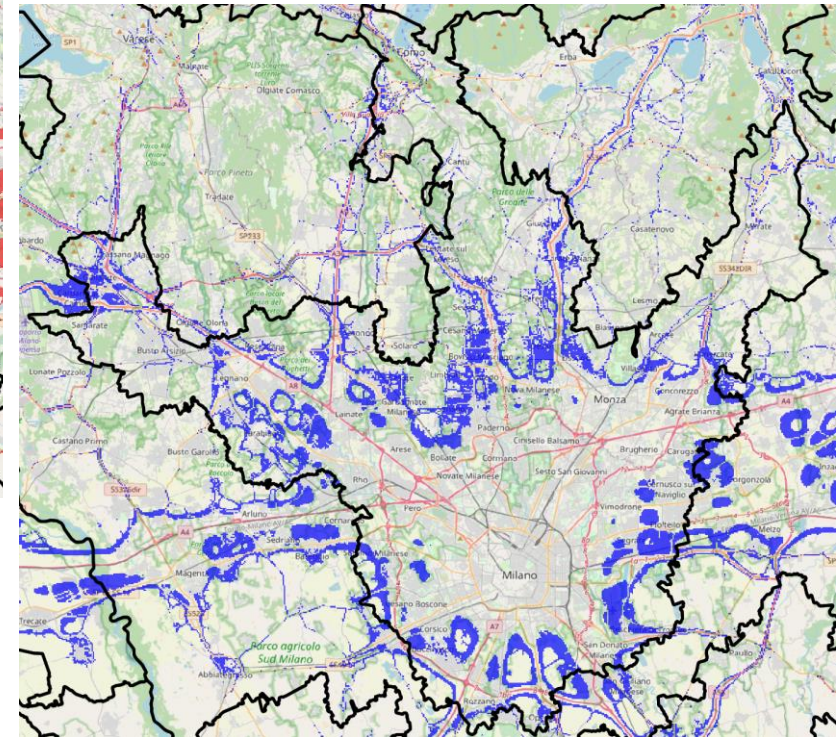
Threshold 20%



Threshold 10%



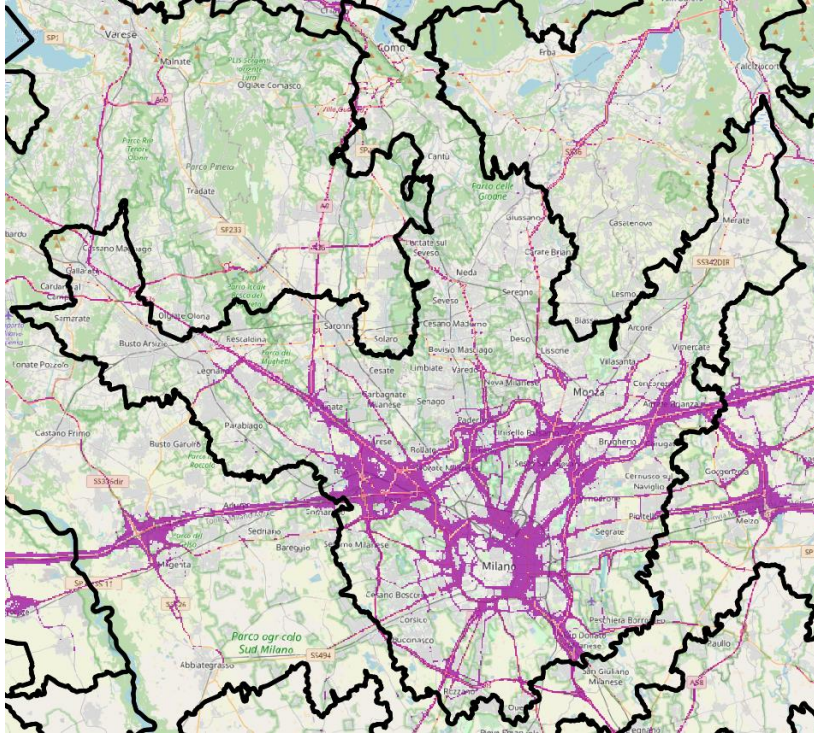
Threshold 5%



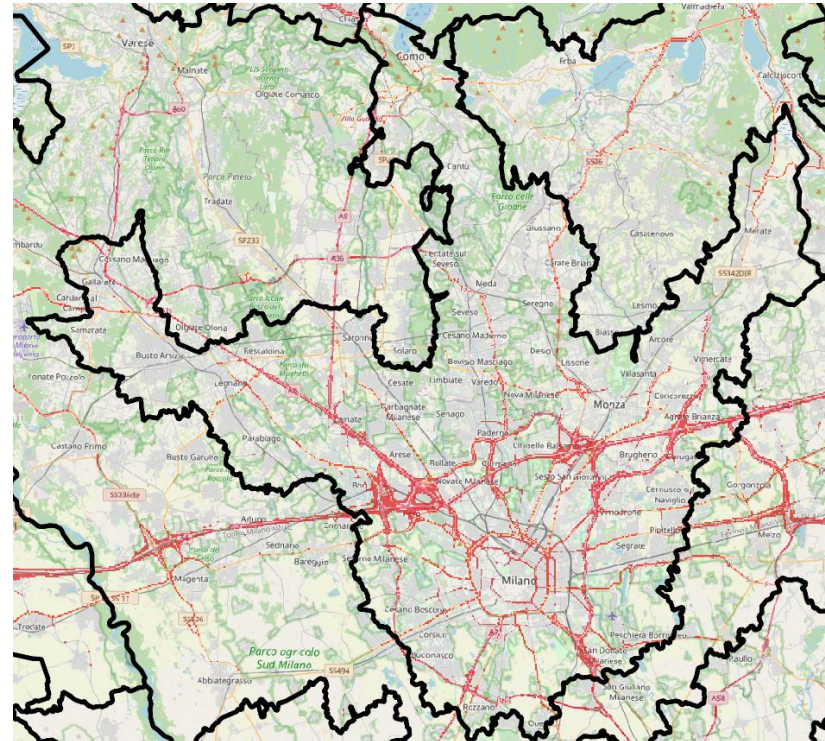
A measurement station somewhere in the Milan AQ zone that measures 30 $\mu\text{g}/\text{m}^3$

100 m resolution spatial representativeness NO₂

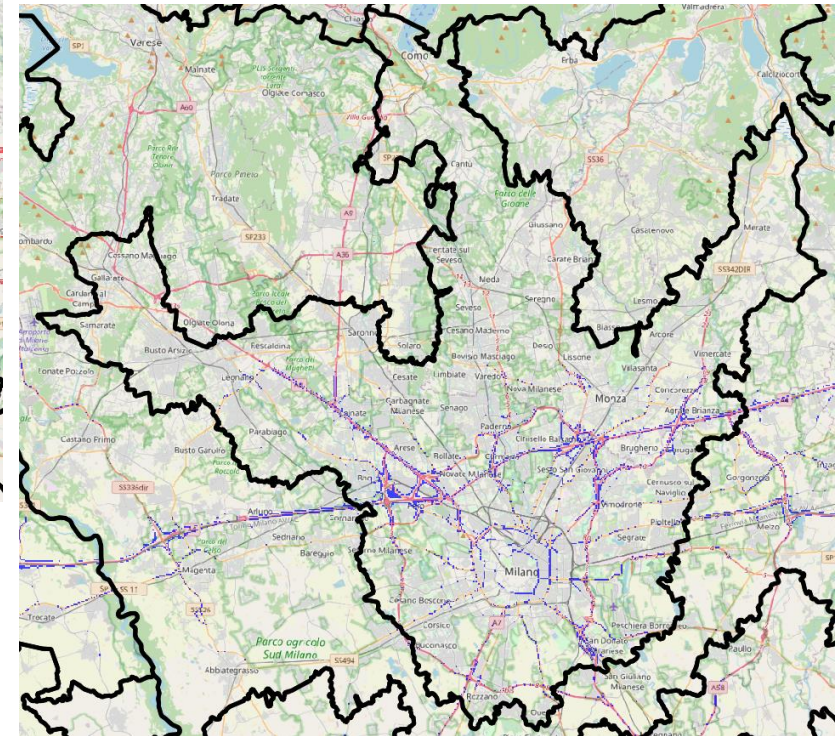
Threshold 20%



Threshold 10%



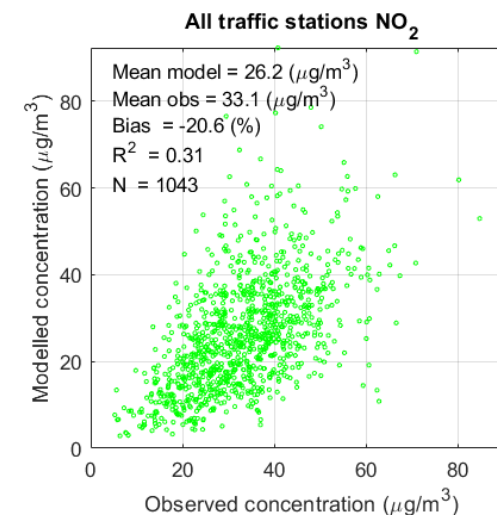
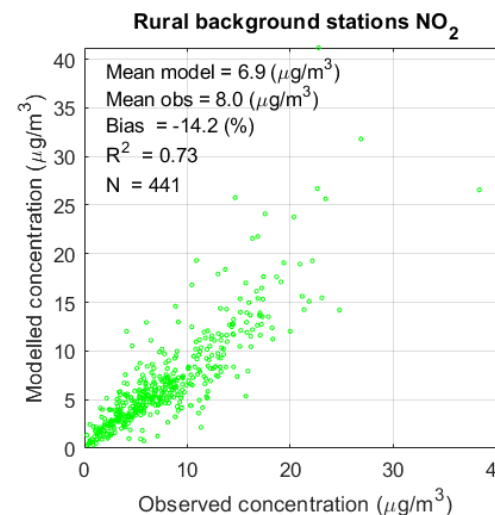
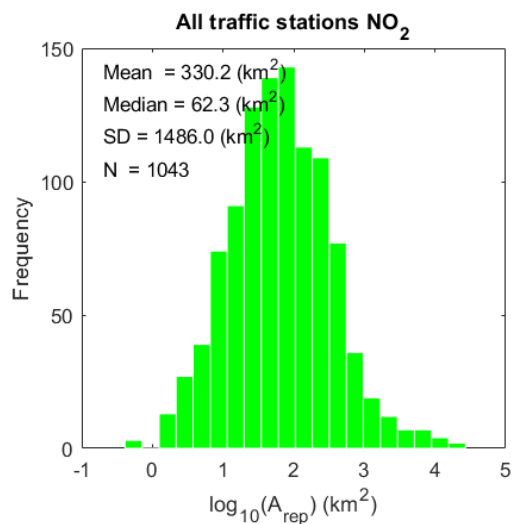
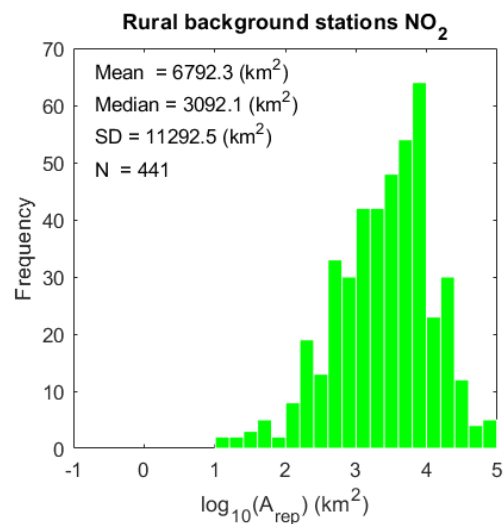
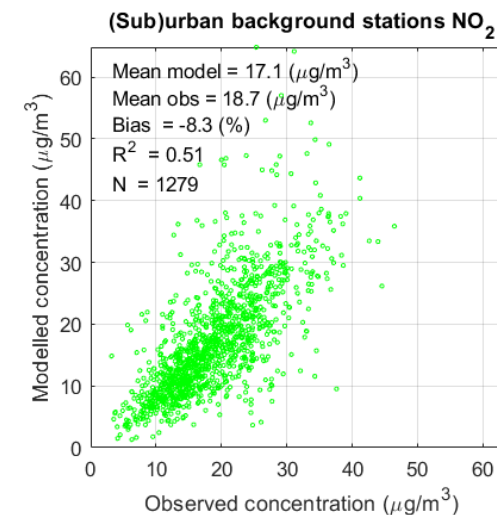
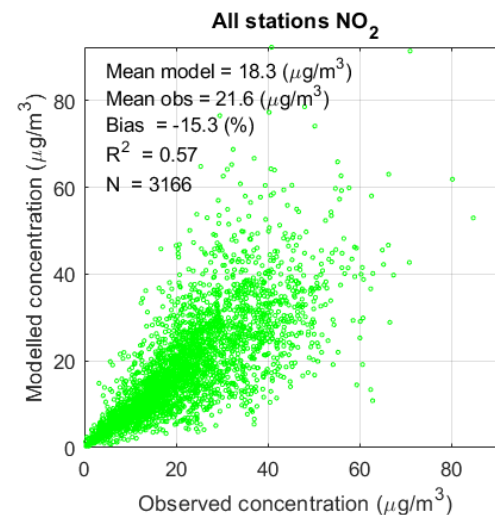
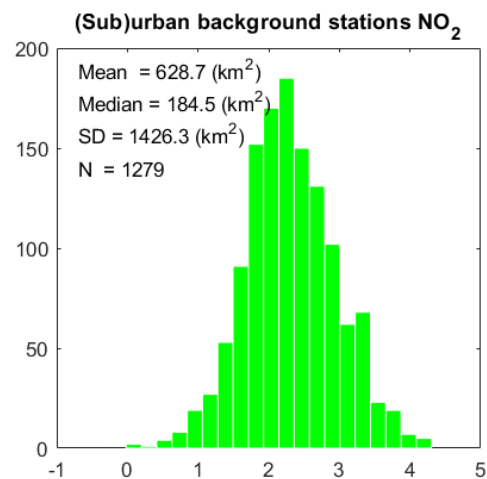
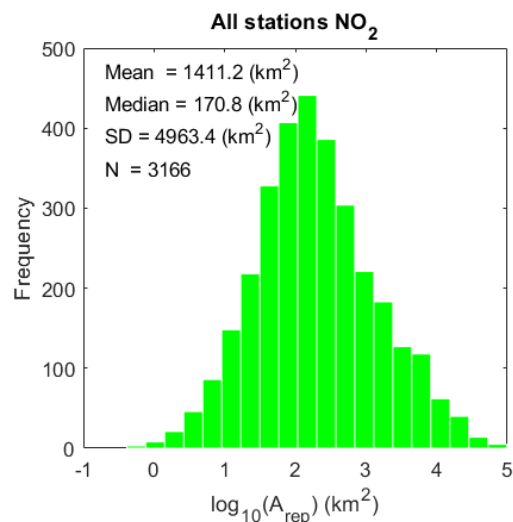
Threshold 5%



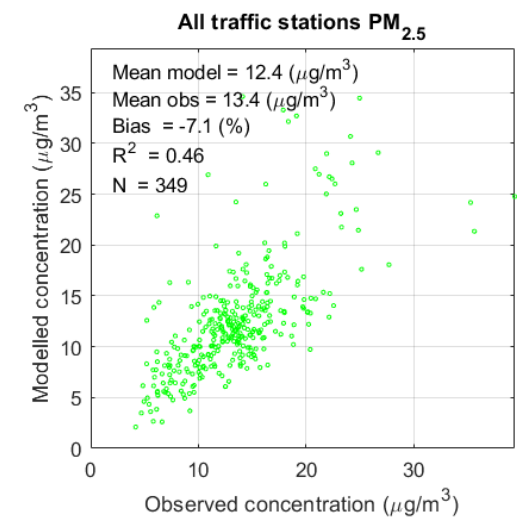
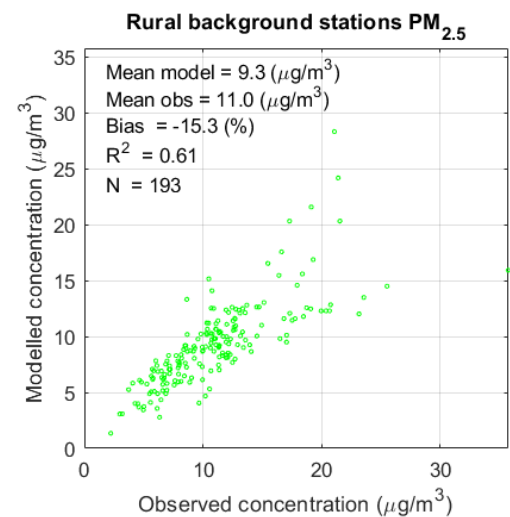
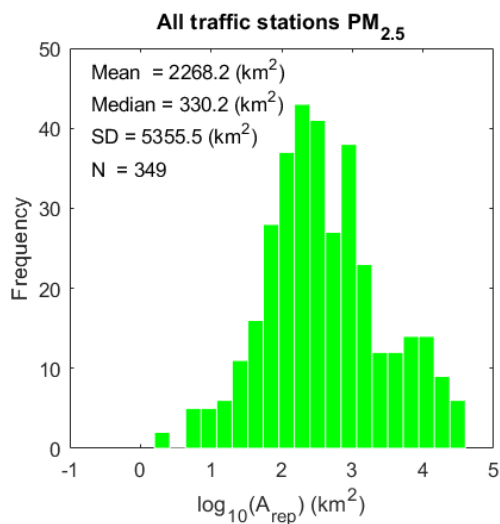
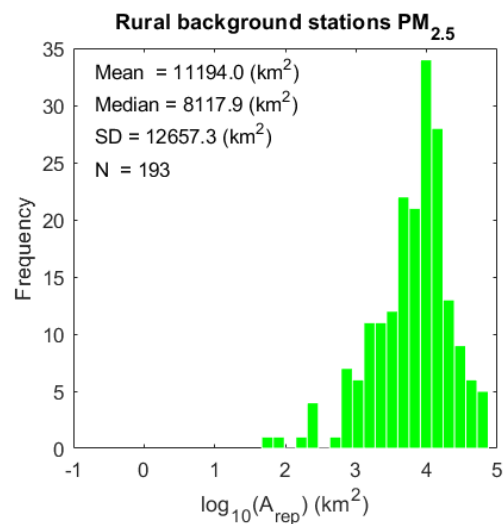
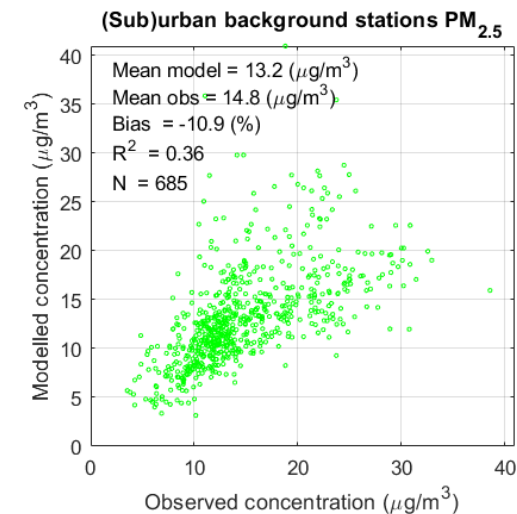
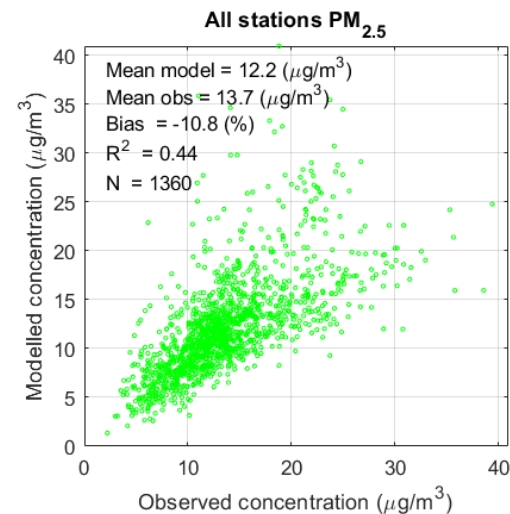
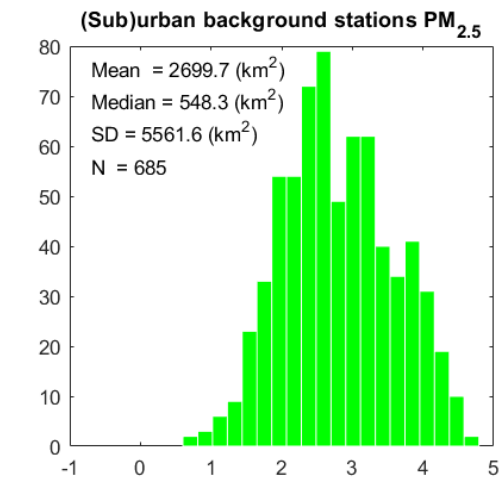
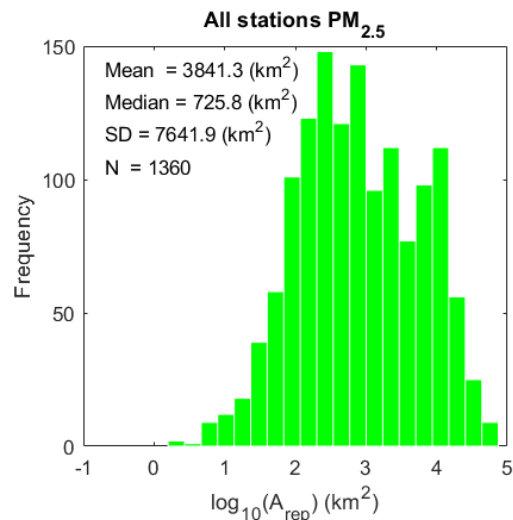
A measurement station somewhere in the Milan AQ zone that measures 50 $\mu\text{g}/\text{m}^3$

Example SRA distributions using 100 m resolution
and a 20 % threshold criteria

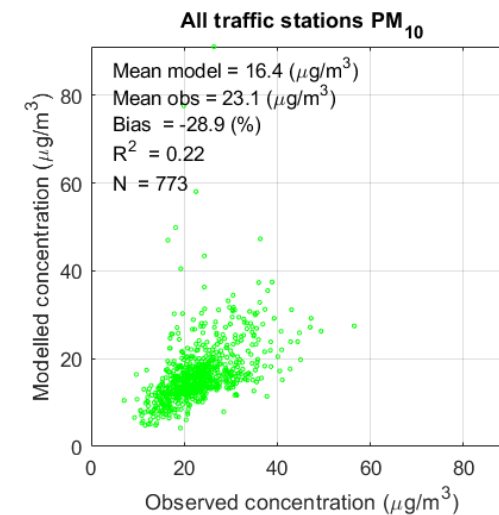
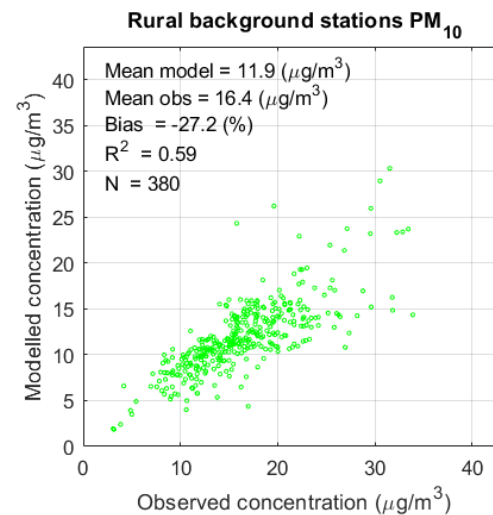
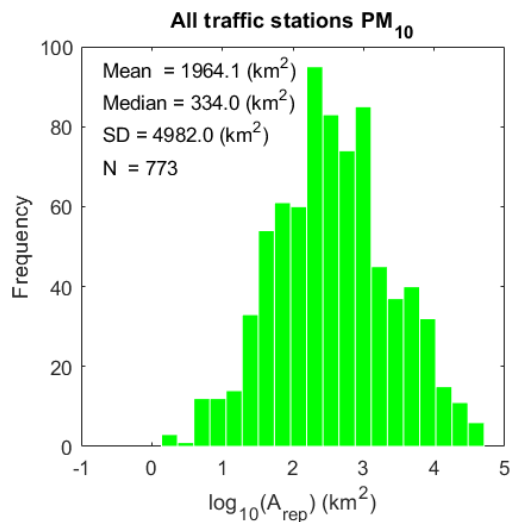
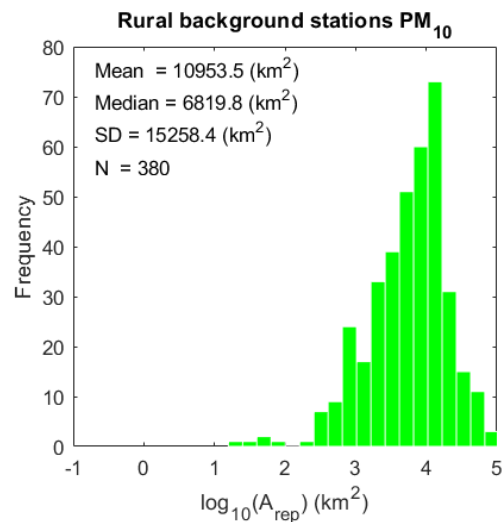
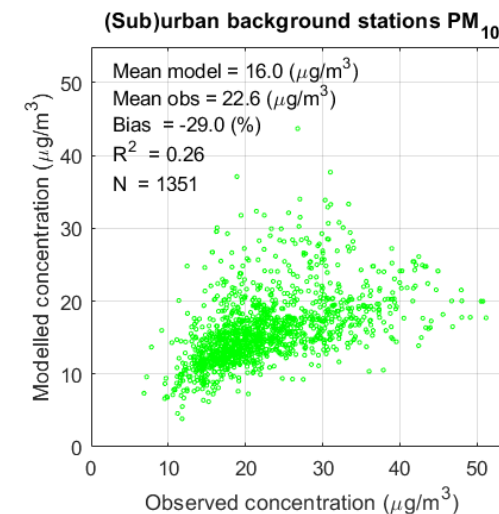
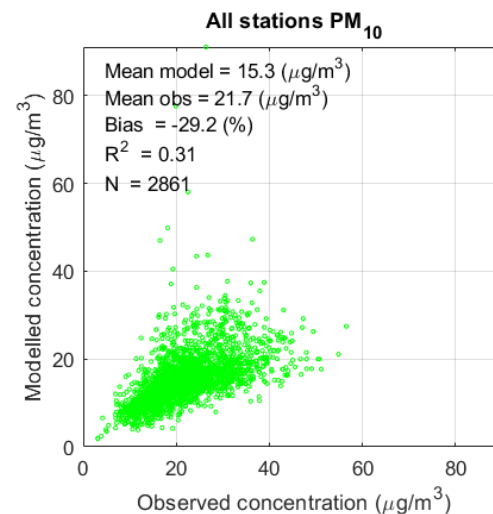
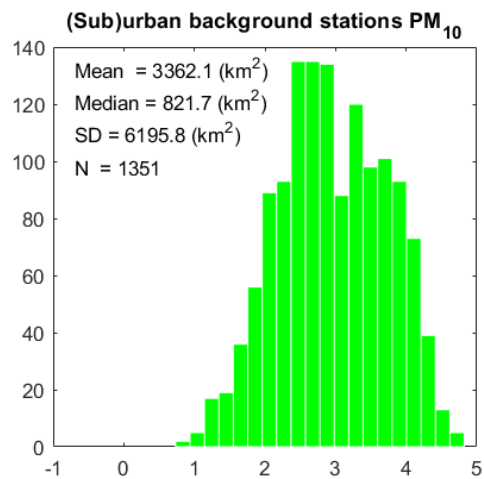
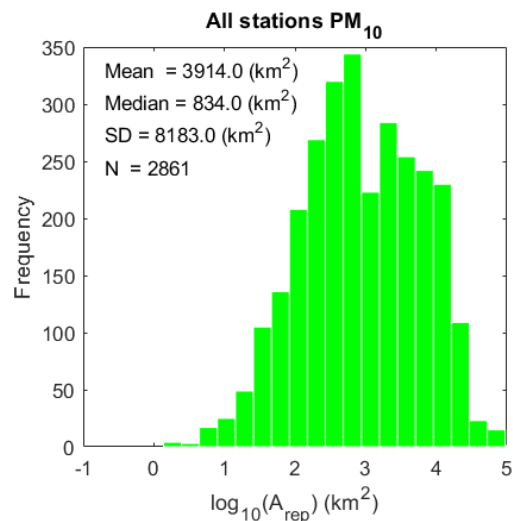
Spatial representativeness area NO₂



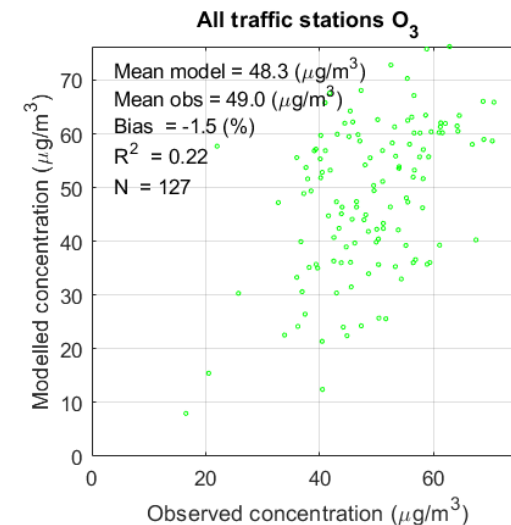
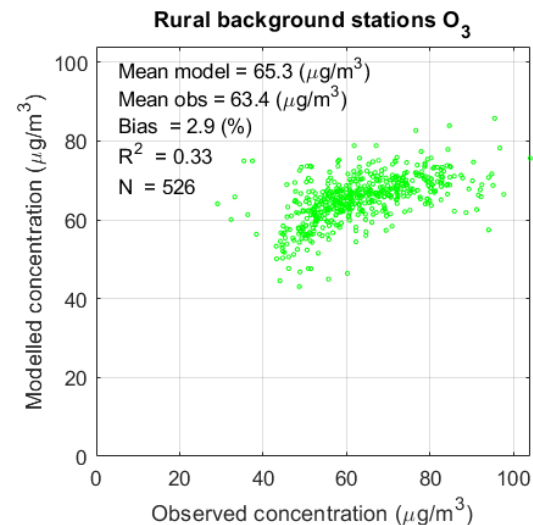
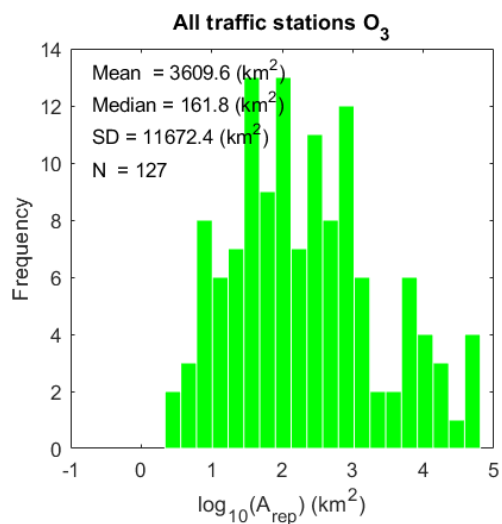
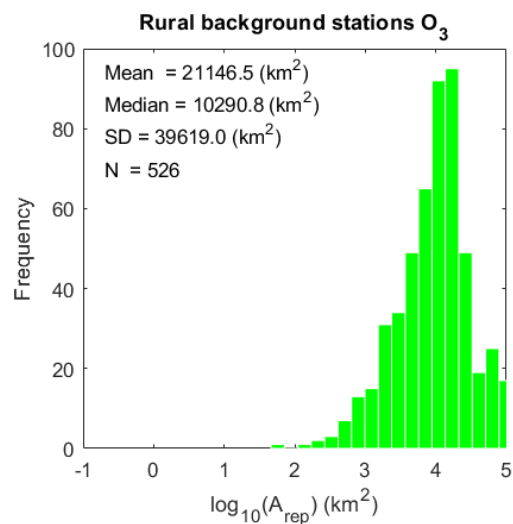
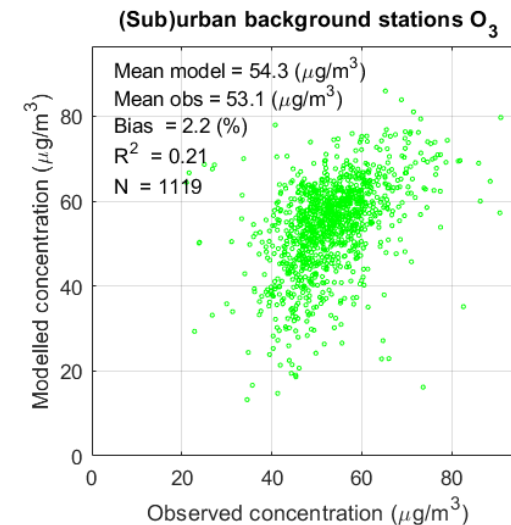
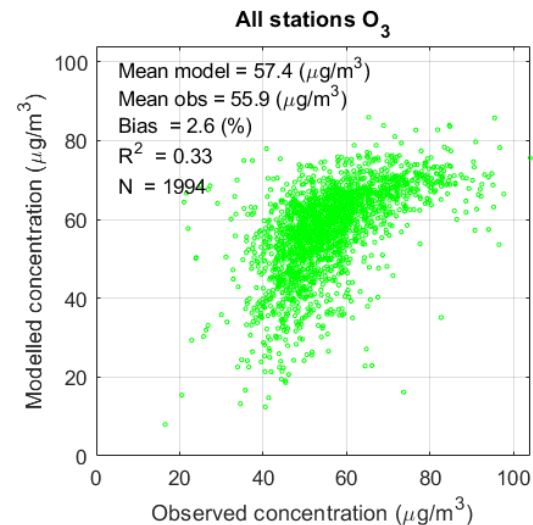
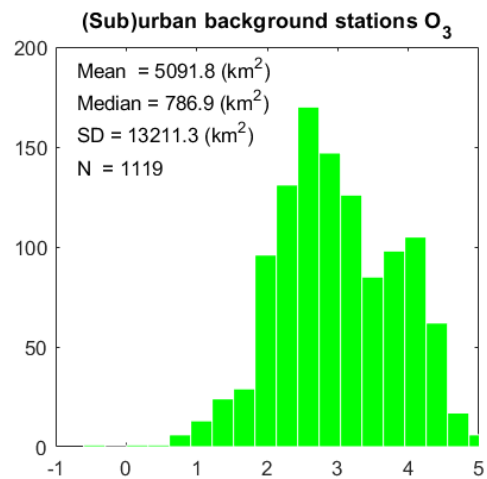
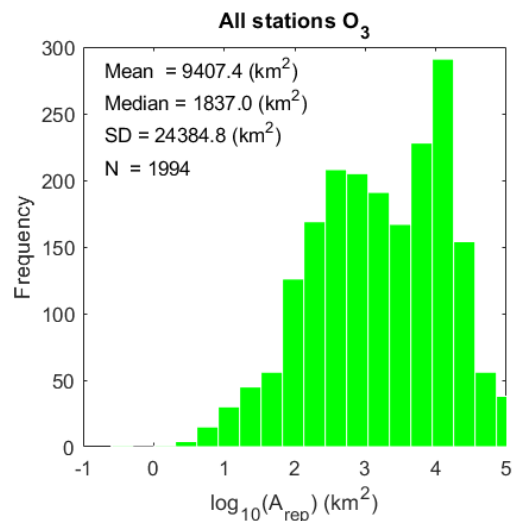
Spatial representativeness area PM_{2.5}



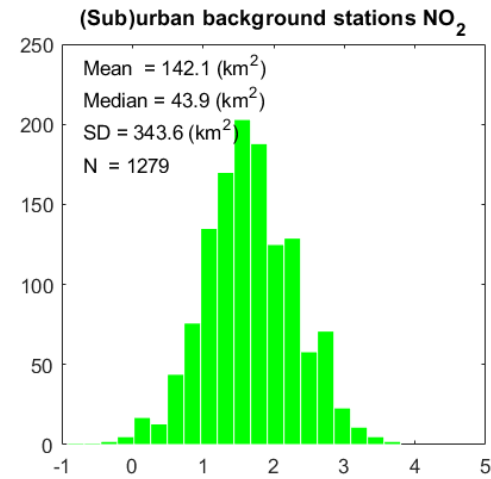
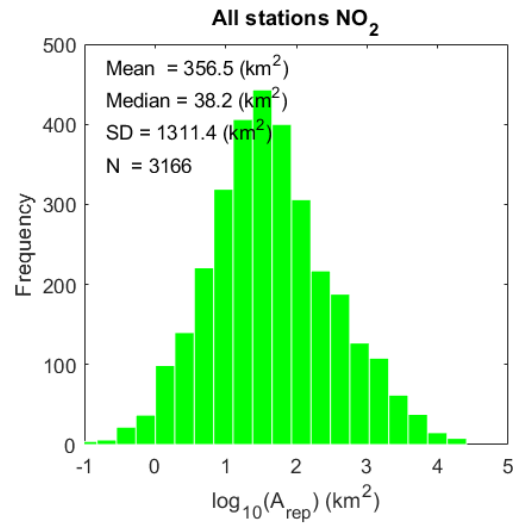
Spatial representativeness area PM₁₀



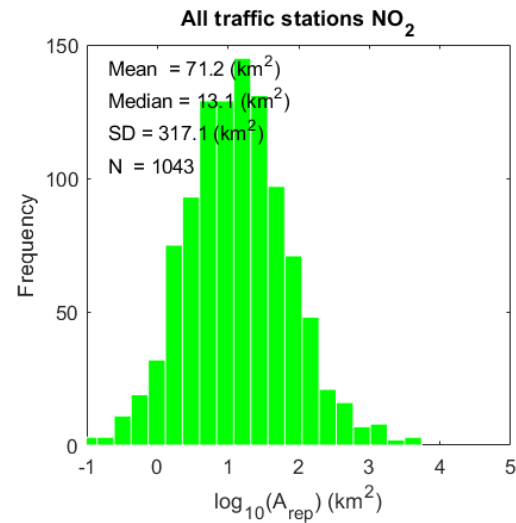
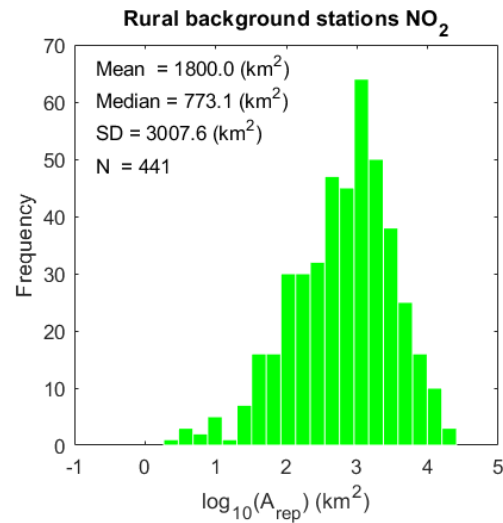
Spatial representativeness area O_3



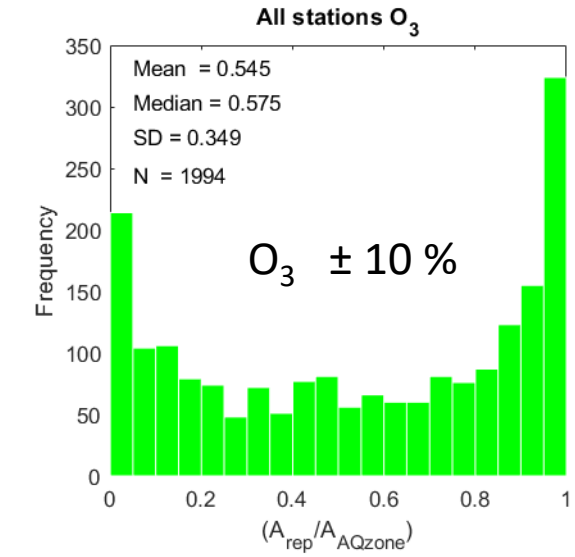
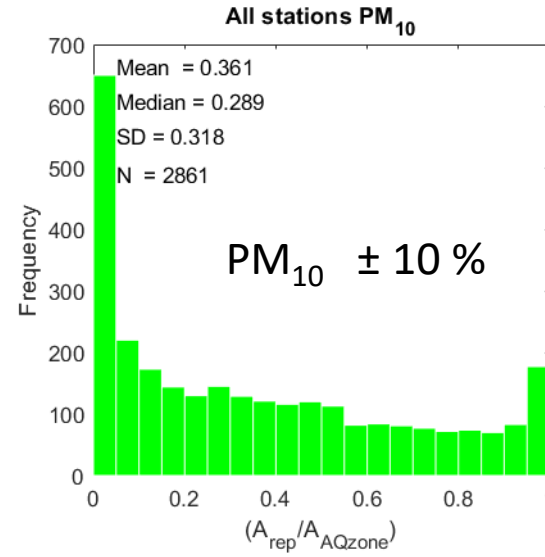
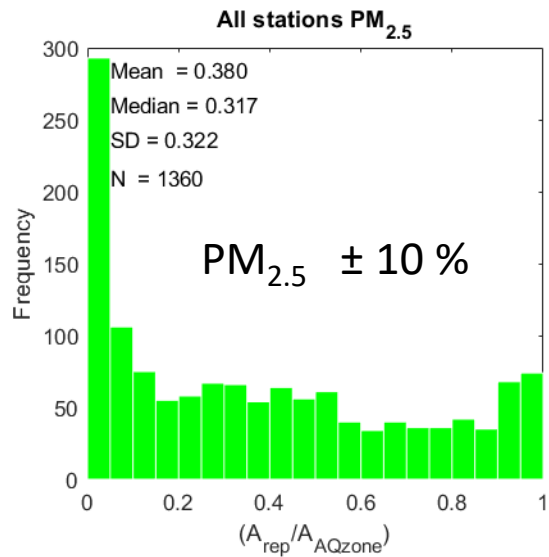
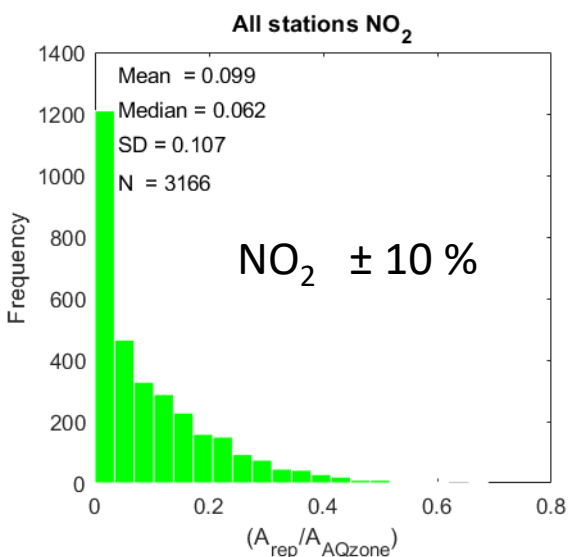
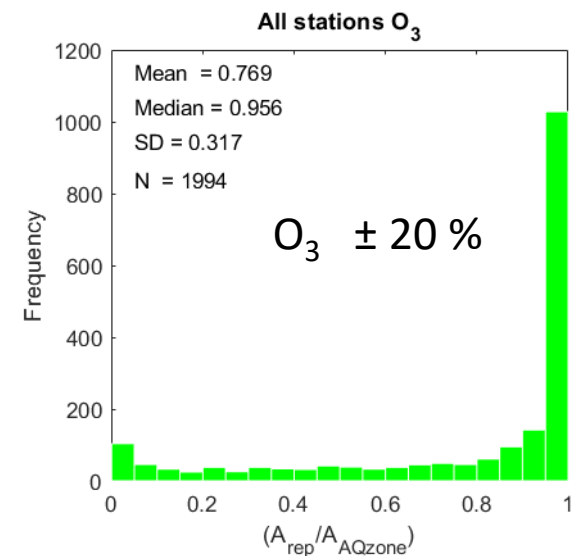
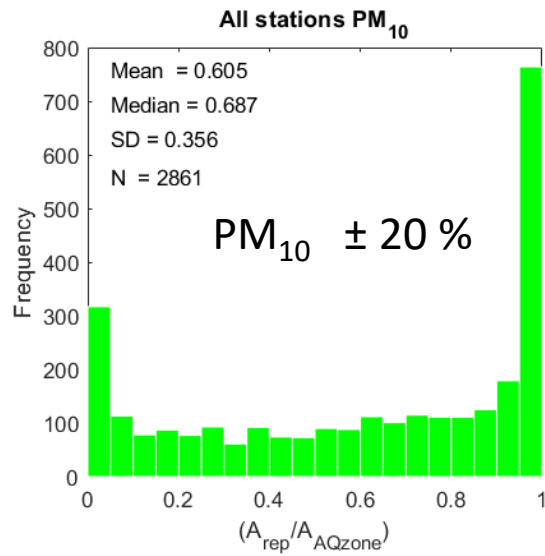
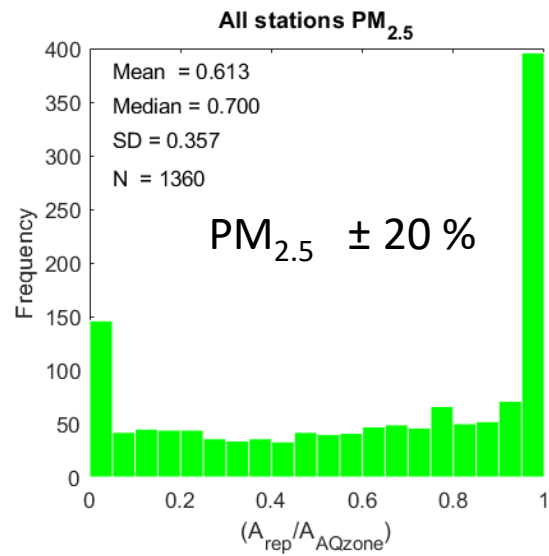
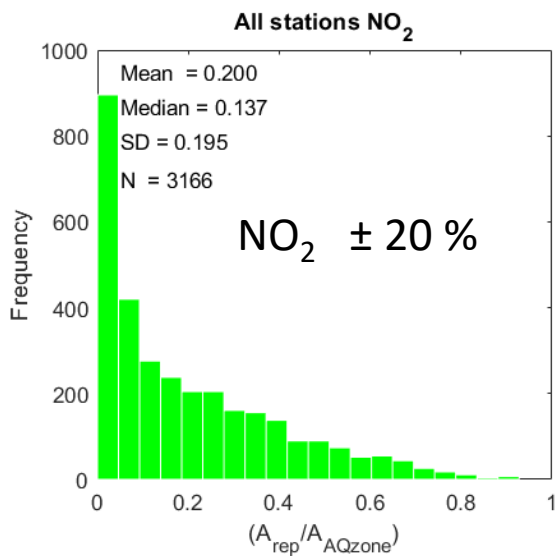
Spatial representativeness threshold value NO₂



Threshold = 5%

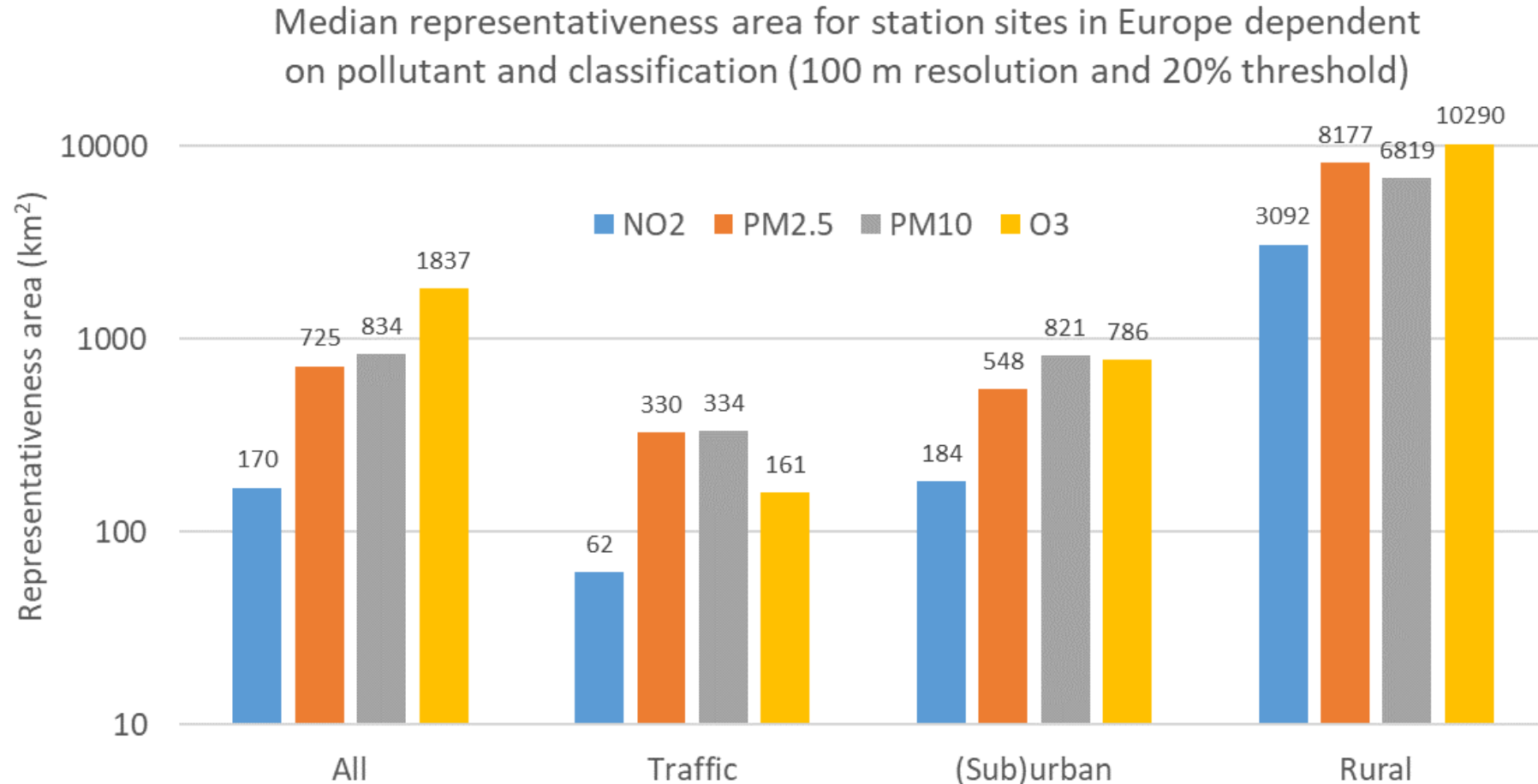


Spatial representativeness area shown as a fraction of the air quality zone area



Summary of the SRA calculations using the median
of the distributions

Summary of the spatial representativeness for $\pm 20\%$

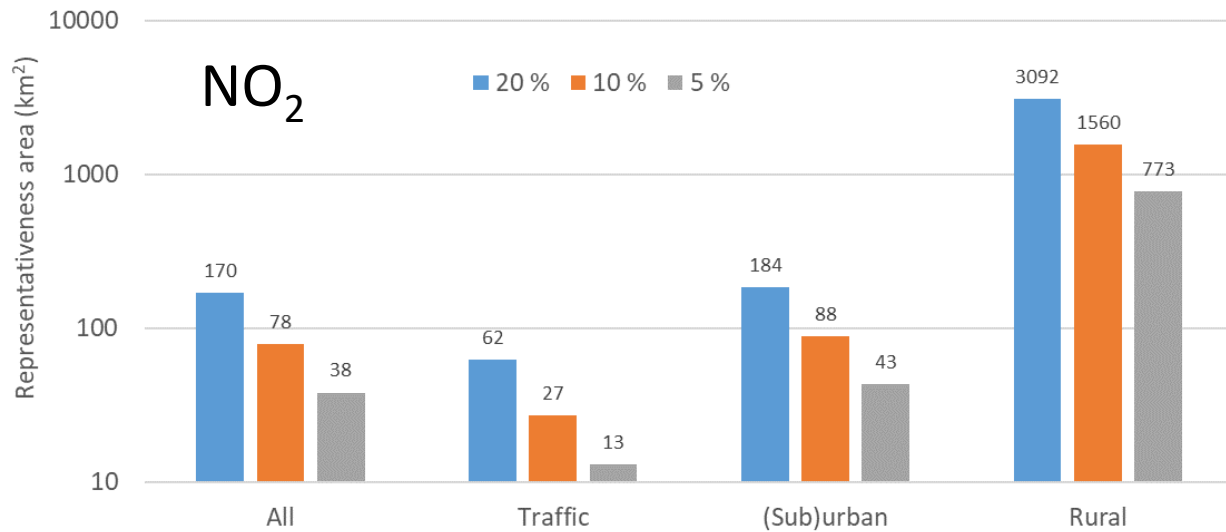


SRA by classification: traffic < urban < rural

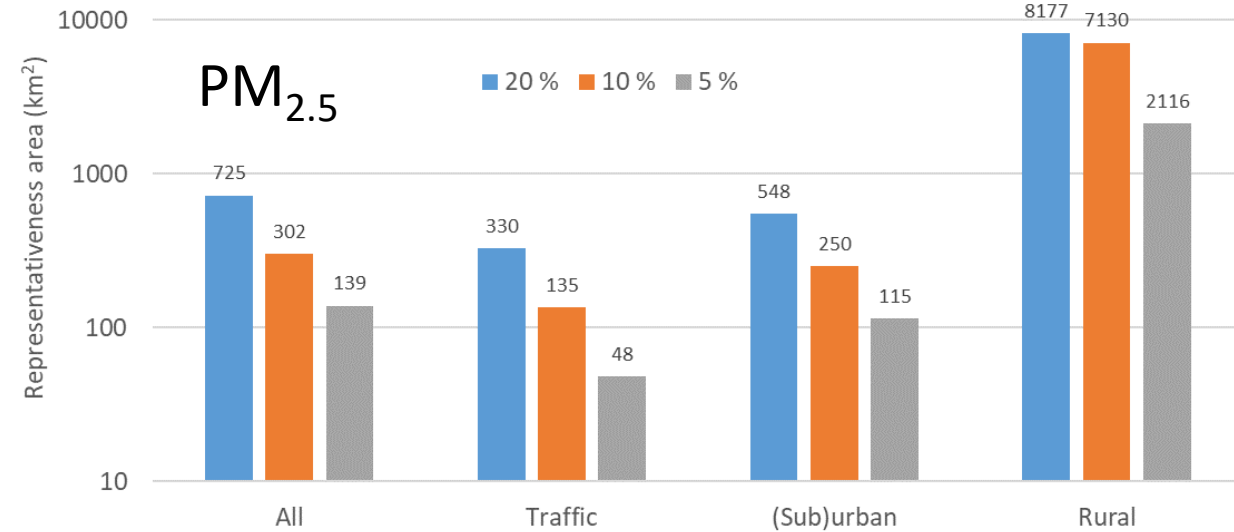
SRA by pollutant: NO₂ < PM ≈ < O₃

Impact of threshold criteria on the spatial representativeness calculation

Median representativeness area for NO₂ station sites in Europe dependent on threshold level and classification (100 m resolution)



Median representativeness area for PM_{2.5} station sites in Europe dependent on threshold level and classification (100 m resolution)



$\frac{1}{2}$ threshold value $\approx \frac{1}{2}$ SRA for all pollutants

Summary of the results

- The SR area follows the expected pattern for the station classifications.
 - Smaller areas for traffic stations and larger areas for rural stations.
- In many cases the limiting area is not the threshold value but the air quality zone perimeter.
 - Reducing the threshold value from 20% to 10% significantly reduces the number of areas limited by the AQ zone perimeter.
- Halving the threshold value has the effect of halving the SR area, consequently for all pollutants.
 - Except when limited by the AQ zone perimeter
- SRAs of just single grid squares (100 m²) are only achieved when using the 10 % and 5 % thresholds (NO₂), but not the 20 % threshold.

General comments

- There appear to be a number of air quality zones that are made up of small distinctly separate regions. Was this considered within the concept of the discontinuous SRA? There are also some AQ zones that are enormous.
- Consider doing this type of calculation by source in order to show what sources the SRA is representing.
- For a more general assessment using models we could assess the SRA for every model grid, not just measurement sites.

Further?

- Station for station comparison with other model calculations from other groups including maps
- It is possible to increase resolution to 50 m (only relevant for NO₂) but this should be limited to specified AQ zones as it is quite a lot of data
- Investigate how sources can be included in the SRA specification

Finished