Intercomparison exercise of the area of representativeness of Air Quality Monitoring Station.

CIEMAT results of Borgerhout-Straatkant traffic station

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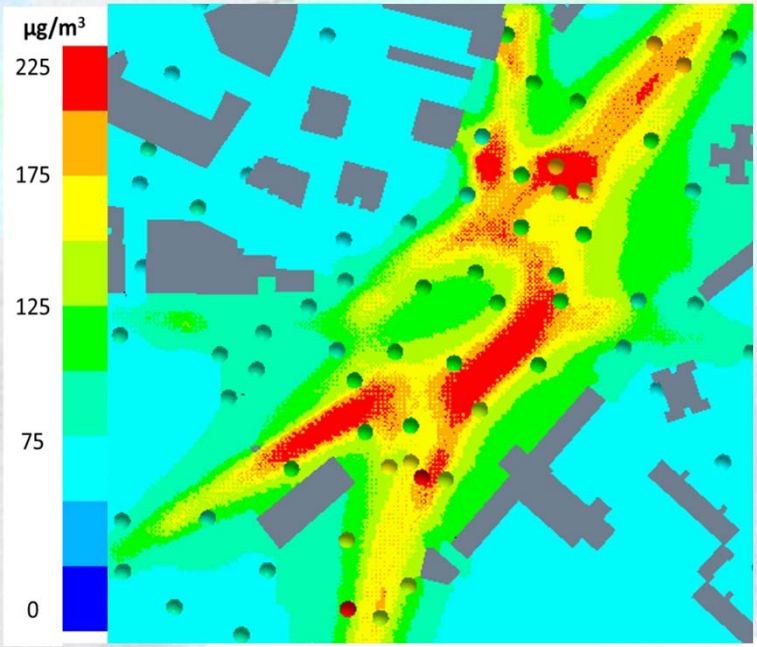
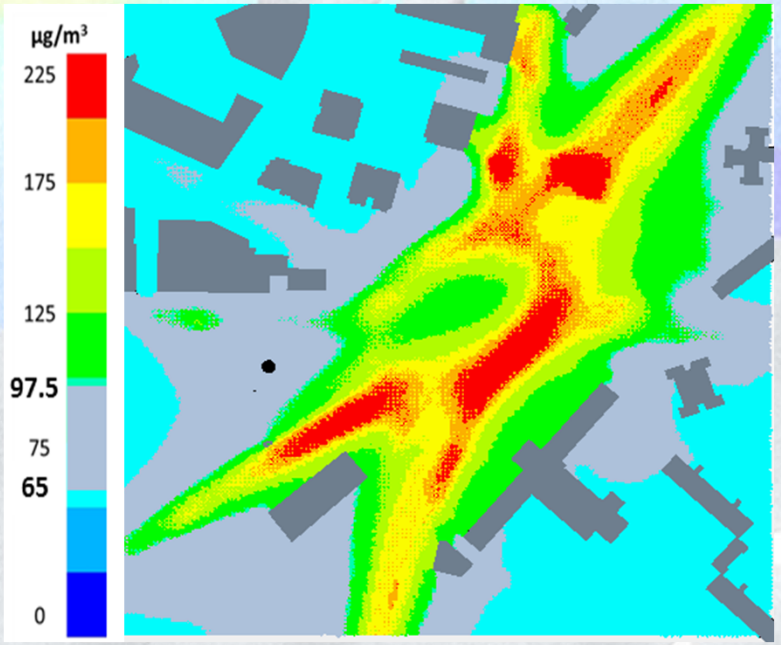
Objective and methodology

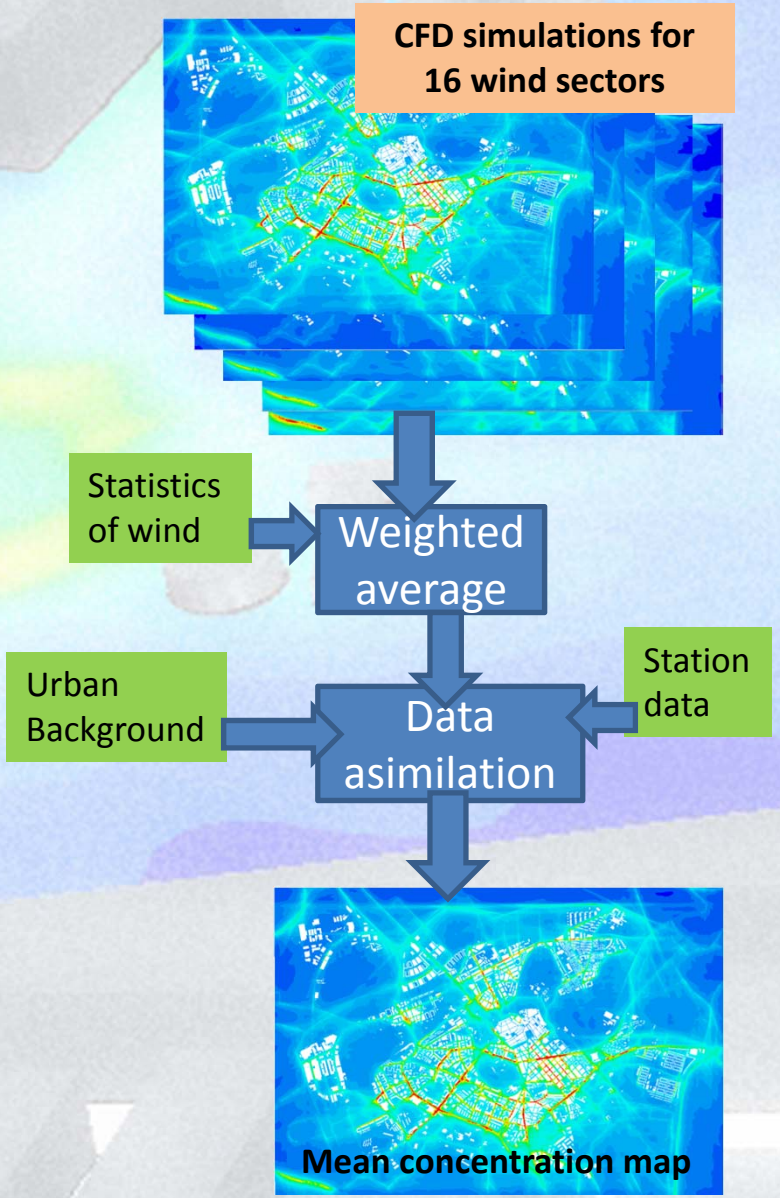
- **Objective:** To compute the area of spatial representativeness (SR) of a traffic station based on concentration similarity
- **Methodology:**
  - Computation of detailed map of NO_2 and PM10 concentration around the traffic station by means of CFD simulations.
  - Computations of the area of representativeness in order to calculate the zone where the concentration of these pollutant is similar to that obtained in the station.



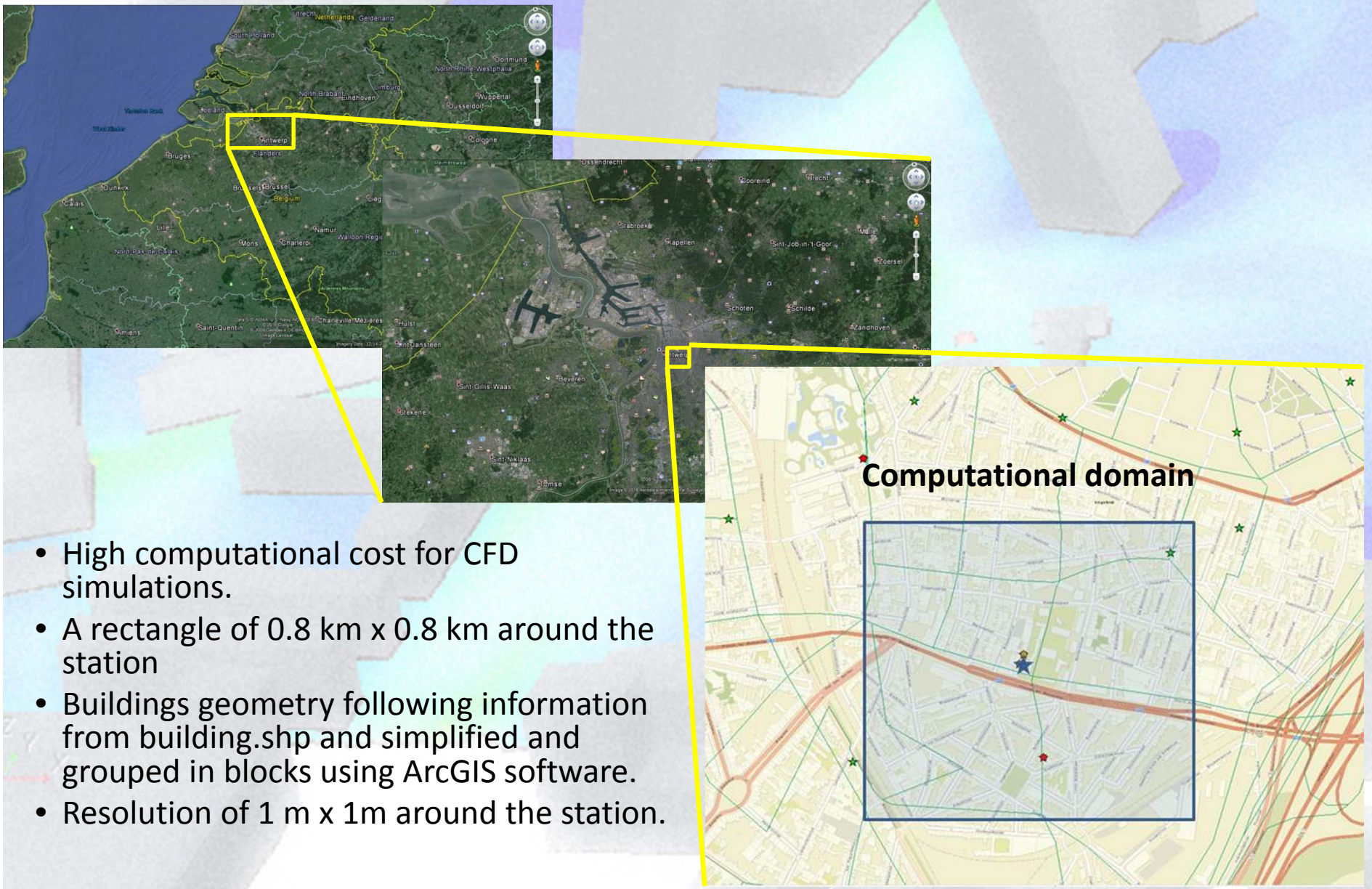


Maps of concentration

- **Methodology to compute concentration maps:**
  - WA-RANS methodology (see Santiago et al. 2013 and Santiago et al. 2017).
  - CFD-RANS simulations for 16 wind directions for PM10 and NO2 emissions
  - Meteorology from M802 station.
  - Frequency and mean wind speed for each wind direction are computed.
  - Average concentration maps are computed based on a combination of CFD-RANS simulations considering frequency and wind speed for each wind sector.
  - Background concentrations from urban background stations



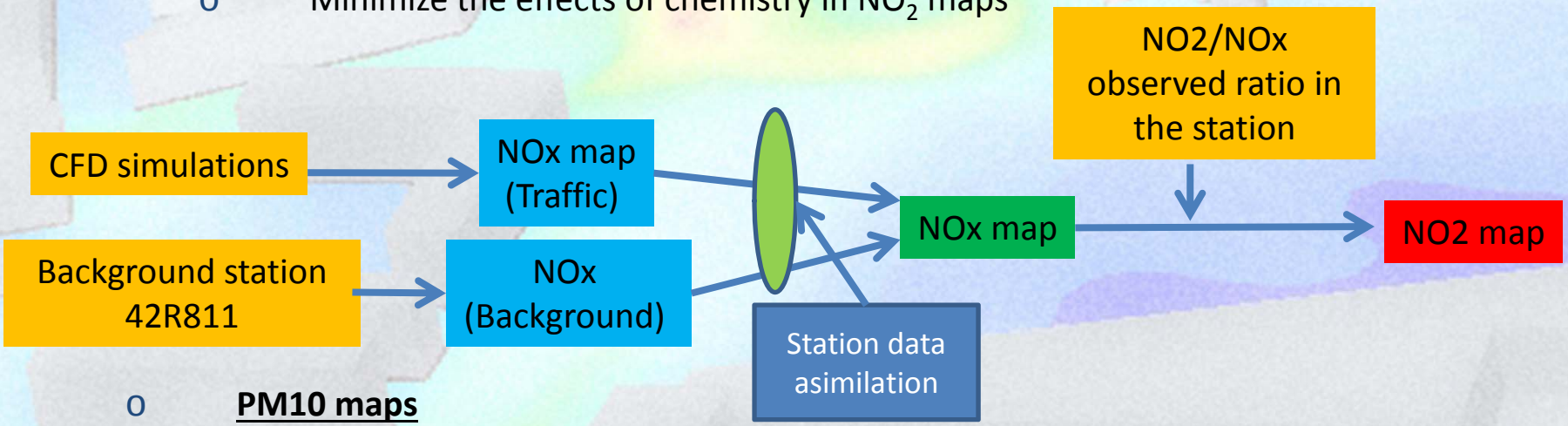
Maps of concentration



- High computational cost for CFD simulations.
- A rectangle of 0.8 km x 0.8 km around the station
- Buildings geometry following information from building.shp and simplified and grouped in blocks using ArcGIS software.
- Resolution of 1 m x 1m around the station.

Maps of concentration

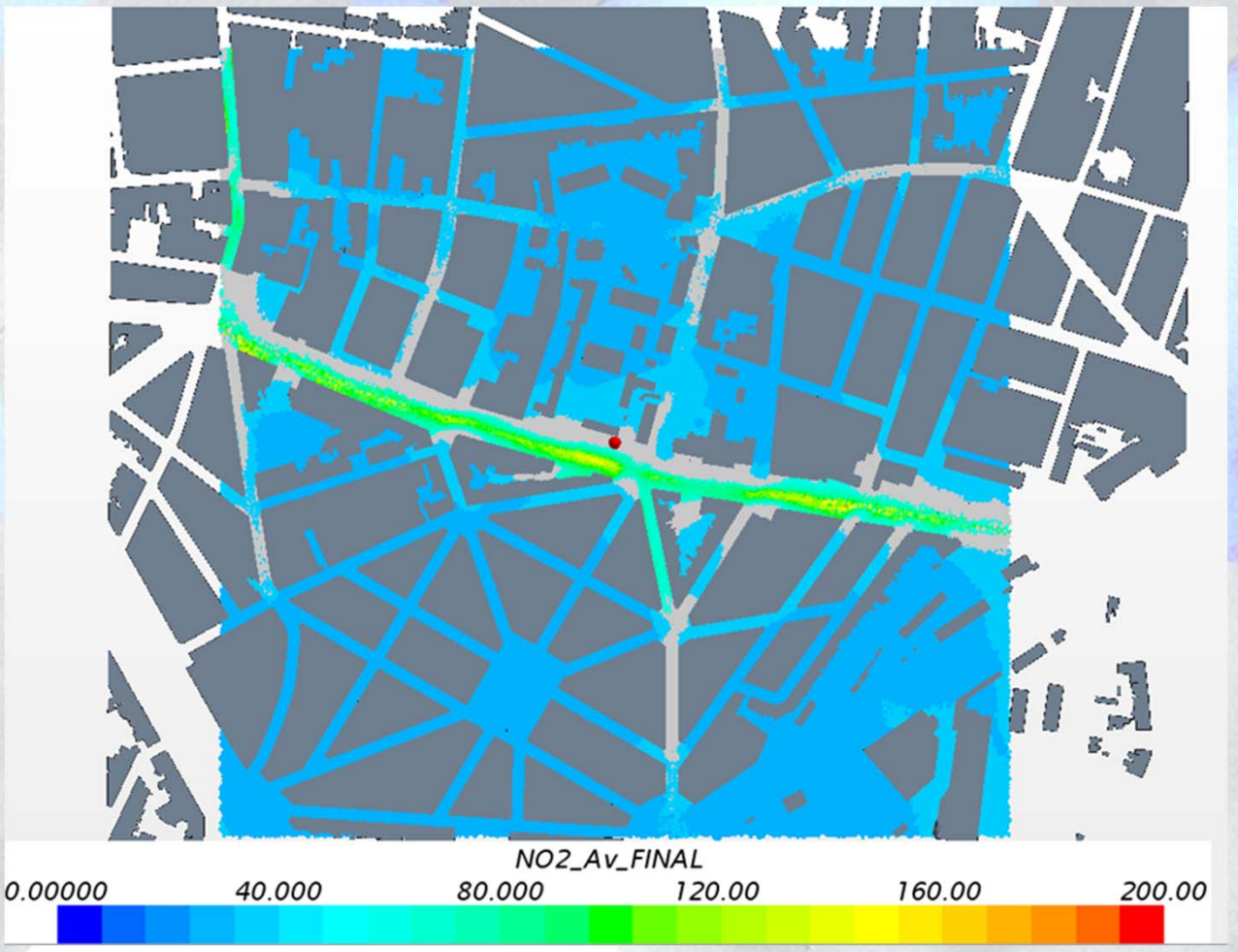
- **Emissions:**
  - Distributed along the street following information given by Road_emissions.csv.
  - A raster with these values were introduced in the CFD model (grid cells 5 m x 5 m).
- **Average concentration map:**
  - Computed in a rectangle of 0.8 km x 0.8 km around the station
  - **NO_2 maps**
    - Minimize the effects of chemistry in NO_2 maps



  - **PM10 maps**
    - Same procedure but PM10 background concentration from 40SA04 station.

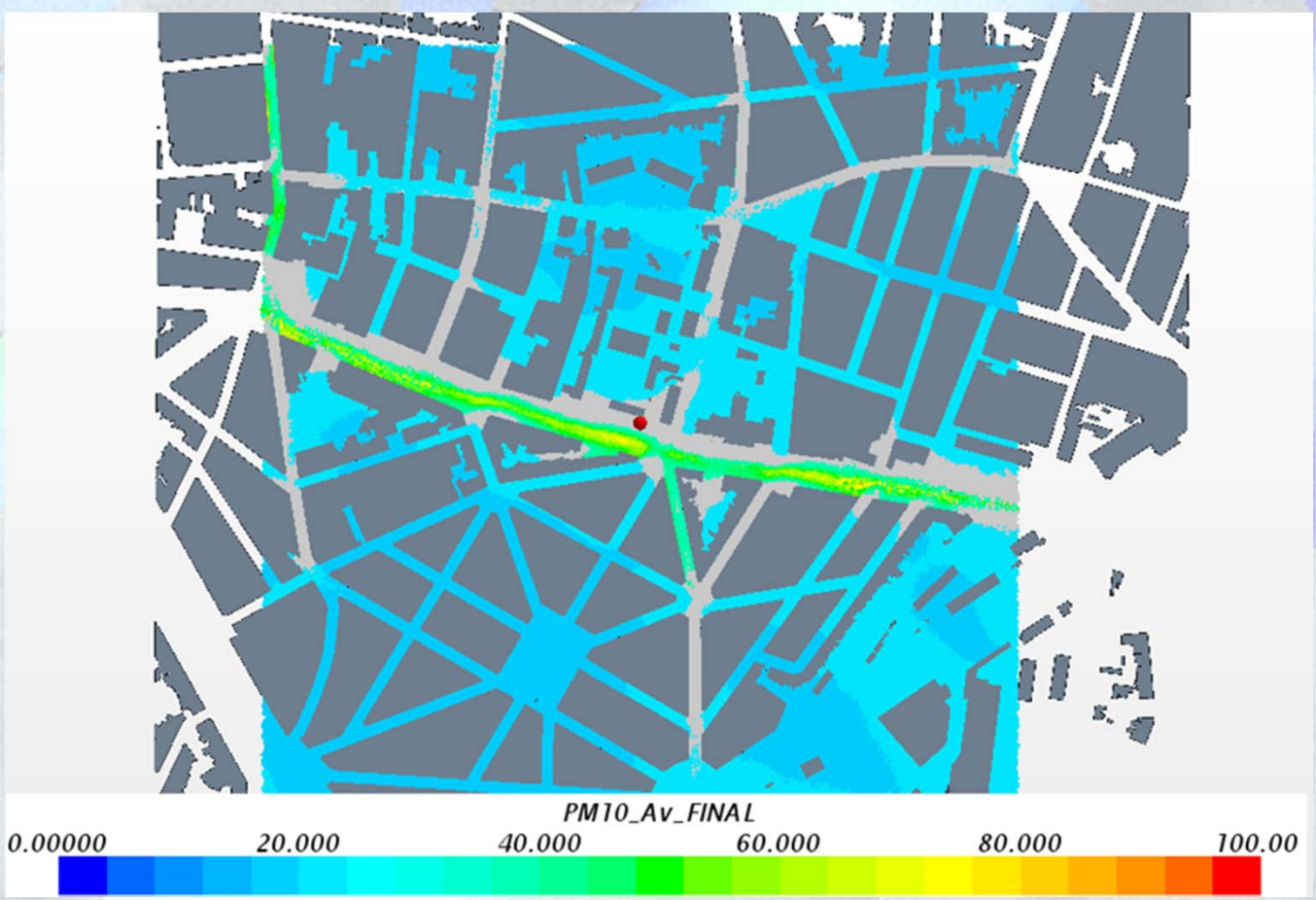
Representativeness Area

- **NO_2:**
  - Threshold = ± 20%
  - NO_2 average concentration at traffic station = 50 µg m^{-3} → Threshold = ± 10 µg m^{-3}



Representativeness Area

- **PM10:**
  - Threshold = ± 20%
  - PM10 average concentration at traffic station = 30 µg m^{-3} → Threshold = ± 6 µg m^{-3}



Representativeness Area

- **Summary of results:**

	NO_2	PM_{10}
Surface area of representativeness in km²	0.032	0.046
Number of inhabitants within the area of representativeness (*)	1284	1899
Density of inhabitants within the area of representativeness (**)	40406.8	41331.1
Mean pollutant value within the area of representativeness (in µg m-3)	46.7	27.9
Standard deviation of pollutant values within the area of representativeness (in µg m-3)	5.4	3.1
Concentration similarity threshold used to estimate the extent of SR	± 20% of the station concentration (± 10 µg m^{-3})	± 20% of the station concentration (± 6 µg m^{-3})

* Total inhabitants of the considered domain is 13812

** The density of inhabitants is computed dividing the number of inhabitants by the surface area of representativeness. The values are very high because in the computation is not taken into account the area occupied by the buildings and the considered area is only located around the traffic station

"Obligatory" slides

Scope, objectives and typical use of the selected spatial representativeness (SR) method

1) What is the **scope** and the detailed **objectives** of your SR method used in the exercise?
   - **General Scope**: To compute SR of a traffic station based concentration similarity
   - **Detail Objective**: To compute a detailed map of NO_2 and PM10 concentration around the traffic station in order to calculate the zone where the concentration of these pollutant is similar to that obtained in the station. The computation of SR is based on results obtained by CFD simulations
2) In which **context** do you typically use this method?
   - In **air quality reporting**
   - In **analysis of station sitting and network design**
3) Are there **other SR methods** that you would typically use in your work on SR assessments?
   - Yes. To compute SR corresponding to rural background station, mesoscale models are used to calculate concentration maps and the similarity criteria for concentration is slightly different (Martin et al., 2014)
4) How does the use of your method(s) relate to local / regional / national / EU-wide **regulatory and /or legal obligations**?
   - This method has not been used for regulatory purposes yet.

"Obligatory" slides

Maturity and fitness to purpose of the SR method used in the exercise

1) How many **years of experience** do you have with the specific SR method used in the exercise?
   - About 5 years
2) How many **years of experience** do you have with evaluating SR in general (including experience with other methods?
   - About 5 years
3) How would you rate the **maturity of the SR method** you have used in the exercise?

   (This may reach from "rather experimental" to "well established" – please also comment on the fitness to purpose of you method.)
   - Well established.
4) Is it possible to **apply your method by other institutes** using the tools you have developed?

   (e.g.: Are your tools available to others? Is there a copyright concern? What is the level of difficulty and necessary skills for their implementation?)
   - Yes, the methodology could be applied by other institute. However, it requires of results computed by means of CFD simulations and then it requires expert knowledge about running CFD models.

"Obligatory" slides

Similarity criteria & definition of Spatial Representativenes (1)

1) Please summarize the underlying **definition of SR** you have used in the exercise.
   - We define the representativeness area of the monitoring station, as the area where concentrations are within an interval of ±20% of the concentration at the monitoring station (see Santiago et al, 2013, STOTEN).
2) Please summarize the underlying **similarity criteria & threshold parameters** you have used.
   - ±20% of the concentration at the monitoring station

3) Are there **other SR definitions** and / or **similarity criteria** you would typically use in your work on SR?
   - Yes, for rural background station, the definition is also based on the similarity criterion (within an interval of ±20% of the concentration at the monitoring station) but includes also the idea of if the station meets the air quality standards, its SR area must also meet them, or on the contrary, if the station does not meet AQ standards, its SR area must not meet them (see Martin et al, 2014).This second condition is because most air quality assessment studies rely on measurements of air quality stations. If the measured concentration data at one station show that any air quality standard is not being met, the authorities require an estimation of the surrounding area affected.

"Obligatory" slides

Similarity criteria & definition of Spatial Representativenes (2 – some details)

1) Are the boundaries of your spatial SR areas constrained **exactly**, or did you add some additional **buffers or safety factors**?
   - The boundaries of our spatial SR areas are exactly computed from modelled concentration maps.
2) Can SR areas of different stations **overlap** or are they considered to be **exclusive** by principal?
   - SR areas of different station could overlap.
3) Are your similarity criteria applied **one sided** or **two sided**?

   (i.e.: Are you evaluating deviations only towards higher values, or towards both higher and lower values?)
   - The similarity criteria applied is two sided (± threshold).
4) Within your estimated SR areas: is spatial representativeness guaranteed for locations of **all station types**, or only for locations of **station types identical** to the type of the central station?

   (e.g.:

   Within the SR areas estimated for the urban background stations Schoten and Antwerpen-Linkeroever: is spatial representativeness guaranteed for locations of all station types? Or for locations of background station type only?

   Within the SR area estimated for the urban traffic station Borgerhout: is spatial representativeness guaranteed for locations of all station types? Or for locations of traffic station type only?)
   - The SR area estimated for urban traffic station Borgehout only corresponds to this station and it cannot be extrapolated to other traffic station. The methodology should be applied again for other traffic station located in other place.

"Obligatory" slides

Input data

1) Please summarize which part of the **input dataset** you have used in the exercise.
   - Geometry information of buildings
   - Road emissions
   - Concentration data from different stations (urban traffic station Borgehout and urban background stations)
   - Meteorological data from M802 station
   - Number of inhabitants in the computational domain
2) Did you use **additional data**, not contained in our dataset?
   (e.g., Street View pictures, maps from other sources, etc.)
   - No additional data were used.
3) How suitable did you find the **Antwerp dataset** for your method? / How suitable would you rate your method to be for this type of dataset?
   - The Antwerp dataset was suitable for used our methodology (applied to the urban traffic station) and also our method was suitable for this type of dataset.
4) Did you **miss** any type of data / information in this dataset?
   - No, the main information was included in this dataset.
5) How does the dataset of the exercise compare to the **data you would more typically use** for you work on SR?
   - The dataset of the exercise are similar to the data we would more typically use for our work on SR.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