



Vlaanderen
is milieu

Spatial Representativity IE

FAIRMODE, Athens, 22nd of June 2017
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Outline

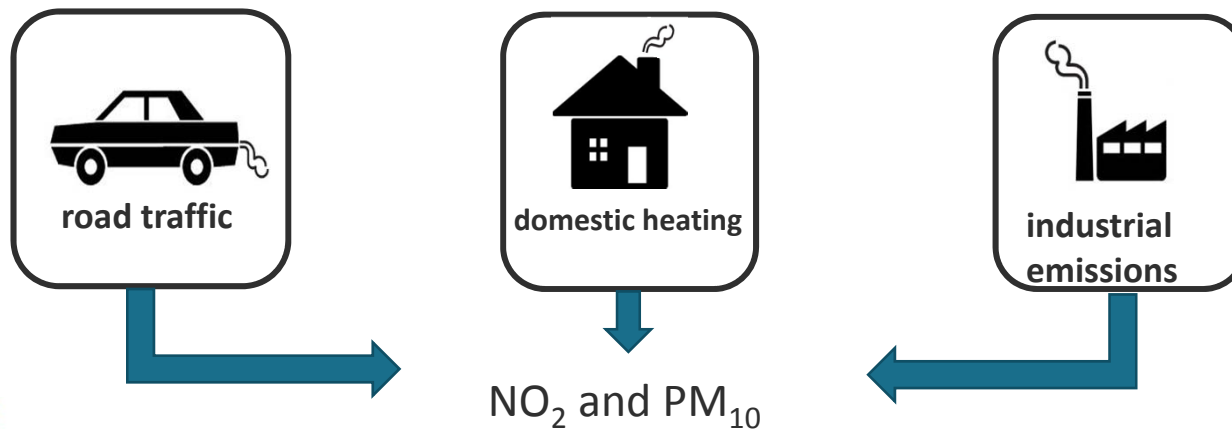
- ▶ **Classification of monitoring stations**
- ▶ **Representative area calculation**

Introduction

- ▶ VMM's method for SR is based Spangl et. al's report *"Representativeness and classification of air quality monitoring stations"* (2007)
- ▶ It is based on Spangl's classification method
- ▶ The classification method was extended to calculate the SR for model validation in the Life+ ATMOSYS project
- ▶ Mainly for pollutants NO_2 and PM_{10}

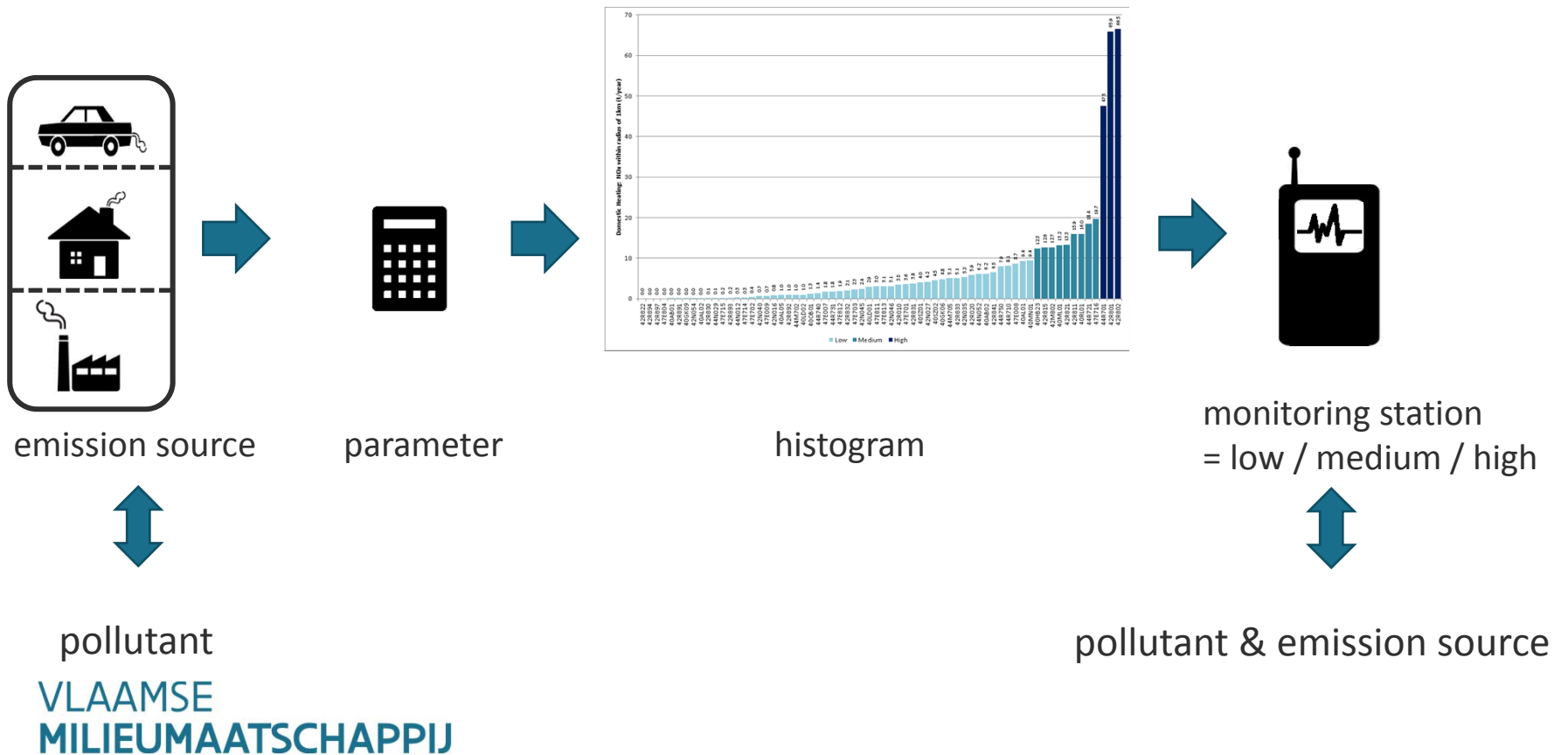
Classification monitoring station

- ▶ **Classification should be ...**
 - based on objective criteria instead of solely expert opinion
 - pollutant specific
- ▶ **Method of Spangl et al. most promising**
 - classification as well as representative area
 - based on emissions of important sources



Classification monitoring stations

- ▶ Histograms are divided into classes (low, medium or high) expressing the emission source influence



Classification monitoring station

- ▶ Final classification (per pollutant) of a monitoring station depends of its classes for these three emission sources

| RT class | DH class | Industrial class | Classification |
|----------------|----------------|------------------|--------------------|
| low | low | low | background |
| low | medium | low | background |
| low | low | medium or high | industrial |
| low | high | low | domestic heating |
| low | medium or high | medium or high | industrial |
| medium or high | low | low | traffic |
| medium or high | medium or high | medium or high | traffic/industrial |

- ▶ The classification of a monitoring station can be different for each pollutant, i.e. for NO₂ traffic and for PM₁₀ industrial

Classification monitoring stations

- ▶ **We compared our results to those in Airbase 2012, but:**
 - the Airbase classification is based on (subjective) expert opinion
 - the Airbase classification is (currently) not pollutant specific
 - the Airbase classification is dated and not revised since 2000

 - ▶ **Our results are a first attempt at a ‘true’ objective classification of VMM’s monitoring stations**
 - important for the selection of monitoring stations for air quality model validation

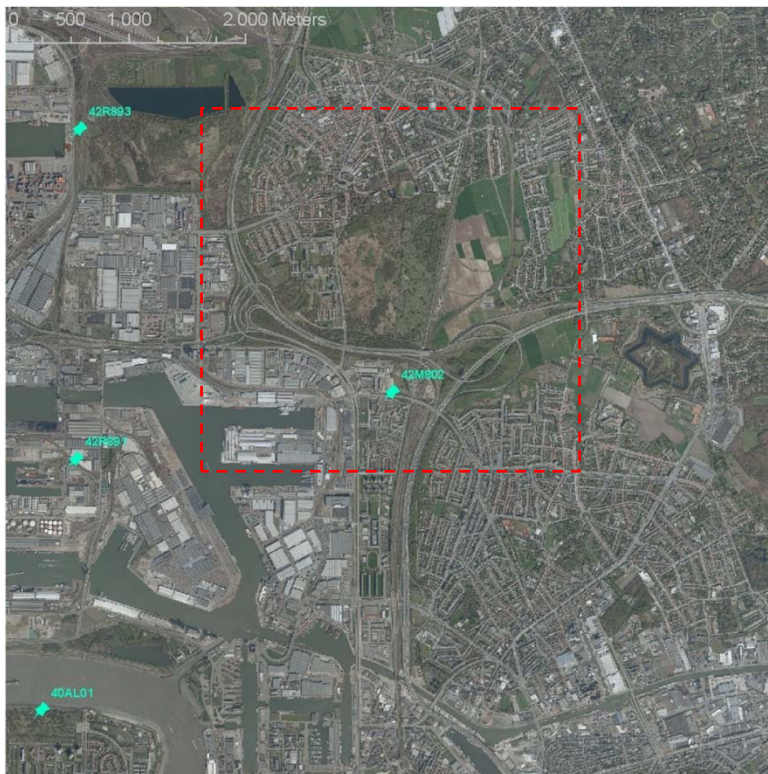
 - ▶ **But ...**
 - classification = at exact location of monitoring station (point)
 - model calc. = inside a 3x3km (or 1x1km) grid
- repeat the classification procedure inside a grid

Representative area

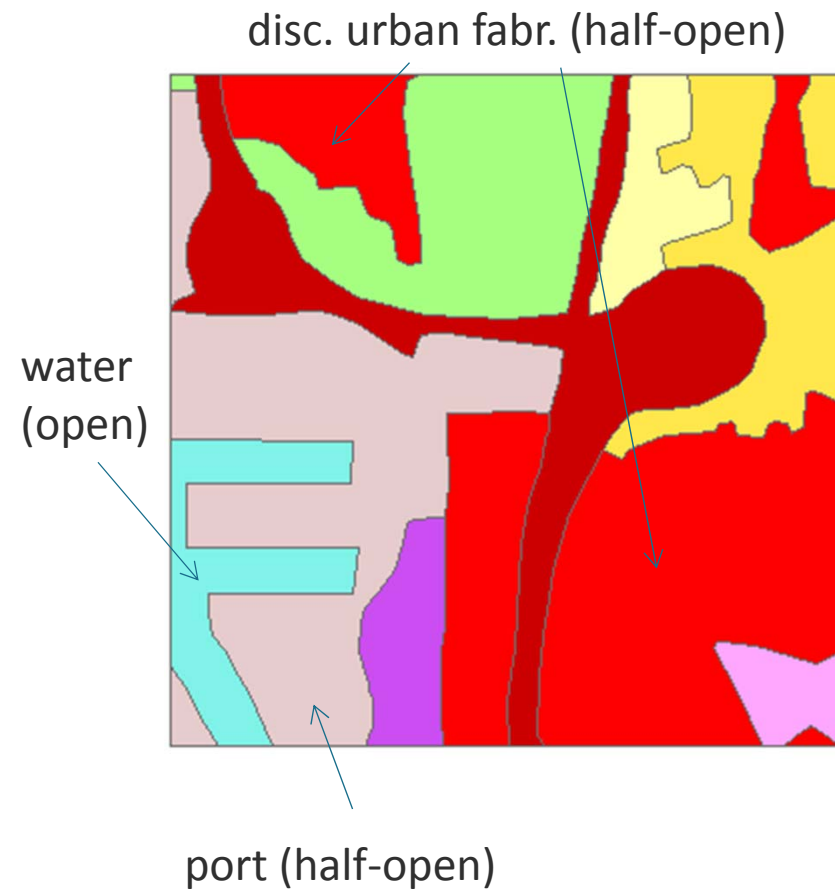
- ▶ **Construct grid around each monitoring station with same dimensions as AQ model (monitoring station at the grid centre)**
- ▶ **For each grid cell:**
 - Repeat the same classification procedure
 - Also, consider land usage (local dispersion)
- **leads to maps for each emission source and pollutant**
- ▶ **The final validation map is a combination (weighted sum) of each of these partial maps.**

Local dispersion

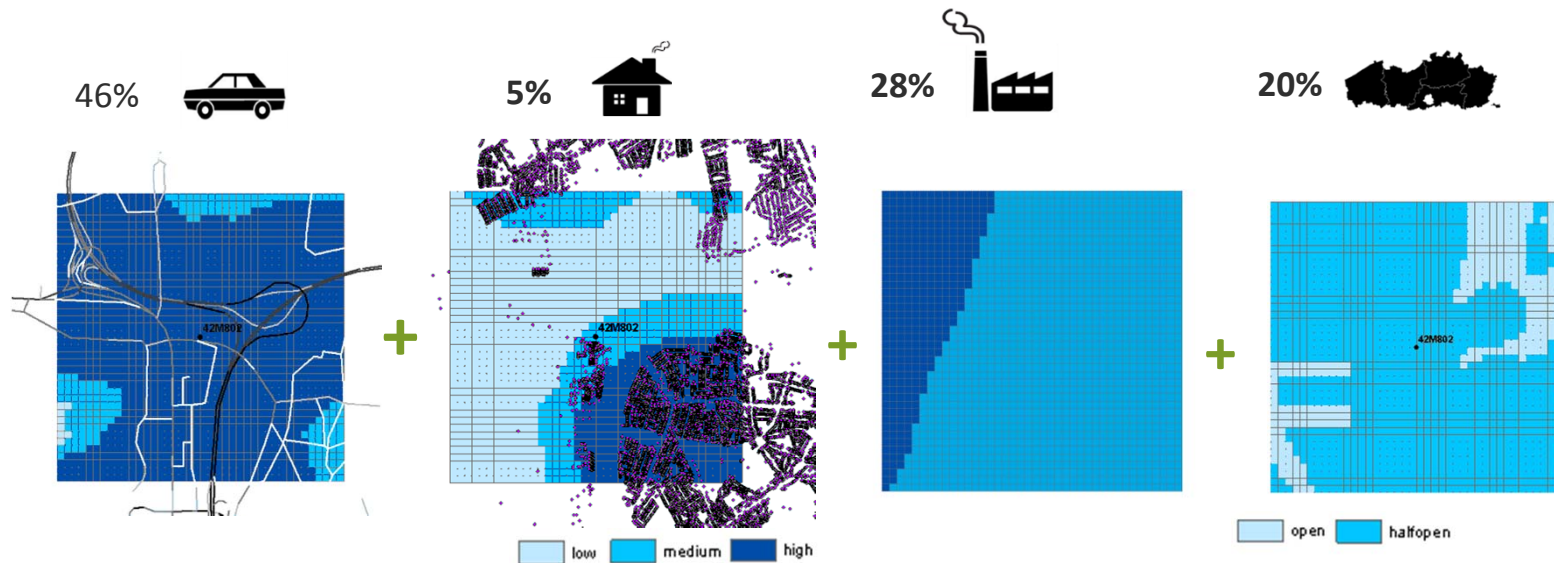
- ▶ Classification of CLC map into general categories open, half-open and closed



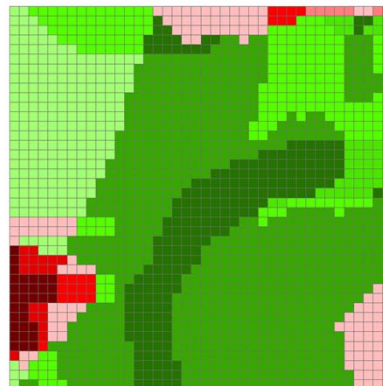
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








Example NO₂



















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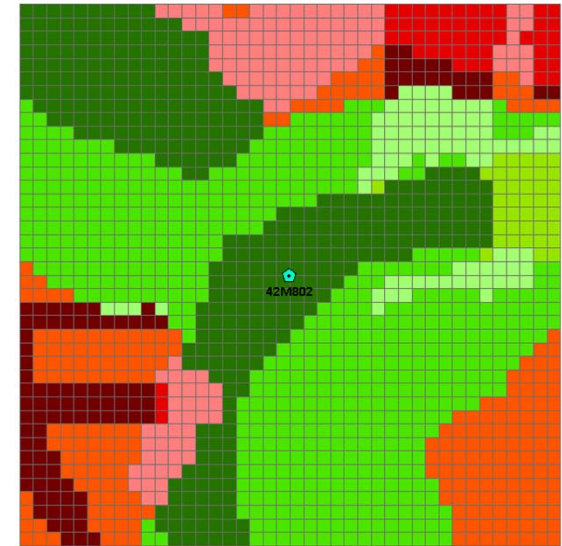
| Class CLC | Class RT | Class DH | Degree of similarity | Grid cell map colour |
|-----------|----------|----------|----------------------|---|
| +1 | +1 | +1 | excellent |  |
| +1 | +1 | -1 | very good |  |
| -1 | +1 | +1 | good |  |
| -1 | +1 | -1 | mediocre |  |
| +1 | -1 | +1 | poor |  |
| +1 | -1 | -1 | very poor |  |
| -1 | -1 | +1 | bad |  |
| -1 | -1 | -1 | very bad |  |

Legend





-  -100
-  -89,6
-  -60
-  -49,6
-  -43
-  -32,6
-  -7,4
-  -3
-  3
-  7,4
-  32,6
-  43
-  49,6
-  60
-  89,6
-  100

Representative area

- ▶ How much (%) of the surrounding area is similar to the measuring station depends on the used criterion for similarity (i.e. color)







NO₂

| | | |
|-----------|---|--------------|
| excellent |  | 16% x |
| very good |  | 75% v |
| good |  | 78% v |
| mediocre |  | 89% v |

Aerial photo

PM₁₀

| | | |
|-----------|---|--------------|
| excellent |  | 23% x |
| very good |  | 60% v |
| good |  | 62% v |
| mediocre |  | 67% v |



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

- What is the **scope** and the detailed **objectives** of your SR method used in the exercise?

Based on the method of Spangl. et al, which is classification method. But extended to calculate the SR area as well.

- In which **context** do you typically use this method?

Originally developed in the Life+ ATMOSYS project to determine the representative monitoring stations to assess AQM.



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

- Are there **other SR methods** that you would typically use in your work on SR assessments?

Not really, at VMM mainly expert judgement is used as a “method” to determine new locations for measurements.

- How does the use of your method(s) relate to local / regional / national / EU-wide **regulatory and /or legal obligations**?

Could be used to help find new locations for monitoring stations with a large(r) representative area. Also to do network pruning, to determine which existing monitoring stations to keep and those that can be removed.



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

- How many **years of experience** do you have with the specific SR method used in the exercise?

The method was developed in 2012, but not actively or routinely used.

- How many **years of experience** do you have with evaluating SR in general (including experience with other methods)?

See previous.

- How would you rate the **maturity of the SR method** you have used in the exercise?

Rather experimental at this stage, the underlying method is sound and developed, but the (software) implementation is more like R&D code.

- Is it possible to **apply your method by other institutes** using the tools you have developed?

We can freely distribute our tools (Python ArcGIS code), but it is not very user friendly and there is no manual.



Similarity criteria & definition of Spatial Representativeness (1)

- Please summarize the underlying **definition of SR** you have used in the exercise.
 1. First, make a classification of each monitoring station based on emission and local dispersion data.
 2. Repeat the same classification procedure in a grid surrounding the monitoring station (i.e. introducing virtual monitoring stations).
 3. Calculate the “distance” between the classification for the monitoring station and the virtual mon. station → results in SR map
- Please summarize the underlying **similarity criteria & threshold parameters** you have used.

Similarity criterium is the “distance” between classification results. Threshold parameters are mainly the histogram boundaries in the classification. Weight factors derived from the emissions, for land use arbitrary.

- Are there **other SR definitions** and / or **similarity criteria** you would typically use in your work on SR?

Sometimes expert judgement to verify results.



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

- Are the boundaries of your spatial SR areas constrained **exactly**, or did you add some additional **buffers or safety factors**?

Constrained exactly as 3km around the monitoring station (the AQ model resolution at the time) and with a limited cell resolution (practical to keep calculation times feasible). No buffer or safety factors are used.

- Can SR areas of different stations **overlap** or are they considered to be **exclusive** by principal?

They can overlap.

- Are your similarity criteria applied **one sided** or **two sided**?

Two sided, we can reward (+1, similar classification) or penalize (-1, different classification).

- 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?

For all station types.



Input data

- Please summarize which part of the **input dataset** you have used in the exercise.

| Dataset nr. and data | Used as/for deriving parameter ... |
|-----------------------------------|---|
| 5 – Road_emissions | Calculating the influence from (local) road traffic by considering the summed road traffic emissions for both NO ₂ and PM ₁₀ from all roads within a radius of 1 km. |
| 6 – Pop_Antw_100m | Calculating the population density in a radius of 1 km as a proxy for domestic heating. Note: no difference is made for DH coming from NO ₂ and PM ₁₀ . |
| 3 – NO2 and PM10 annual mean maps | Normally we would use a bi-Gaussian dispersion model IFDM to calculate the NO ₂ and primary PM ₁₀ concentrations coming only from industrial points sources. To save time we used the annual mean maps as a proxy in this exercise. |
| 8 – Corine Land Cover | Assessing the similarity in landuse and dispersion conditions of the (virtual) monitoring station and its surroundings. We reclassified this map to three main categories: open, halfopen and closed. |

- Did you use **additional data**, not contained in our dataset?

No.



Input data

- 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 dataset was complete (even contained too much information) for our method.

- Did you **miss** any type of data / information in this dataset?

No.

- How does the dataset of the exercise compare to the **data you would more typically use** for you work on SR?

See previous.