

# FAIRMODE Spatial representativeness feasibility study: **Feasibility Analysis & Proposal** **for the intercomparison exercise**

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# Outline

- Introduction
- State of the art
- Questionnaire design and replies
- **Feasibility analysis**
- Comments and discussion

# Feasibility analysis

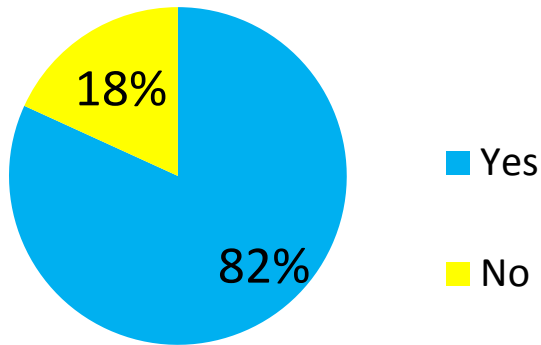
- 1. Problems and objectives of the intercomparison exercise**
- 2. Identification of methodologies**
- 3. Description for Needed Shared Datasets**
- 4. How to compare the outputs of the different SR methods**
- 5. Proposal of SR intercomparison exercise**

# Problems and objectives of the intercomparison exercise

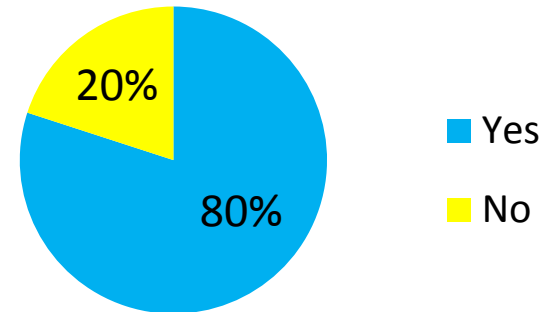
- Main objective of the intercomparison exercise: *to analyse the different contemporary methodologies to compute SR of air quality monitoring stations by applying them to a jointly used example case study.*
- Open the exercise to as many participants and methodologies as possible

# Intended participation

Participation(groups)



Participation(methodologies)



Participation	Number of groups	Number of Methodologies
Yes	18	20
No	4	5
<b>Total</b>	<b>22</b>	<b>25</b>

# Problems and objectives of the intercomparison exercise

## Problems:

1. Large variety of methodologies, criteria and definition of SR.
2. Limitations of each methodology
3. Type of the outputs (features of SR) is different depending on methodology

# Problems and objectives of the intercomparison exercise

## Problem 1:

- Large variety of methodologies, criteria and definition of SR.
  - Some groups did not provide any definition of SR.
  - Mostly the definition depends on the methodology used.
  - Difficult to harmonize the criteria to define the SR area.

# Problems and objectives of the intercomparison exercise

## Problem 2:

- Limitations of each methodology:
  - spatial and temporal scale,
  - type of pollutants,
  - each methodology needs specific inputs.



# Problems and objectives of the intercomparison exercise

## Problem 3:

- Type of the outputs (features of SR) is different depending on methodology.
  - In most cases, the SR area is represented by means of maps
  - Others it is qualitatively described .
  - Therefore, the comparison of methodologies cannot be direct in some cases.

# Identification of methodologies

## Types of methodologies:

- Concentrations maps around monitoring sites computed by:
  - Models: models outputs
  - Measurements: maps from measurement campaigns.
- Proxies: spatial representativeness calculation with proxies.
- Station classification: spatial representativeness estimated depending on the features of the station.
- Qualitative analysis: spatial representativeness calculation according qualitative analysis.

# Identification of methodologies

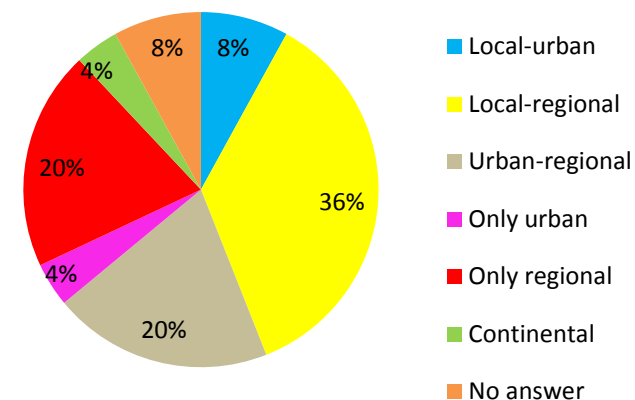
## Limitations :

### Site requirements.

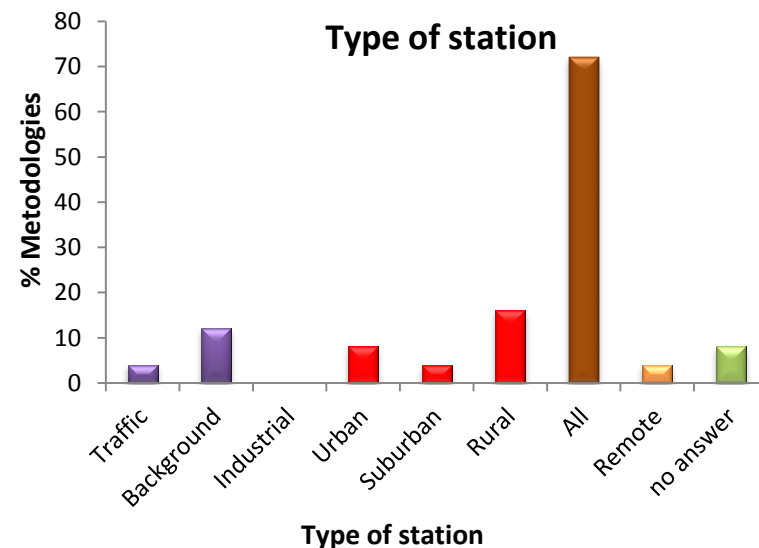
- Two main scales: local-urban and regional
- Type of stations: Most all types, several groups note limitations.

Site requirements	Number of Methodologies	Number of methodologies interested to participate	Number of groups interested to participate
Type of station	6	5	5
Type of area	4	3	2
Extent of the domain	5	5	5
Others	1	0	0
No limitation	5	5	5
No answer	9	6	6

Spatial Scale



Type of station



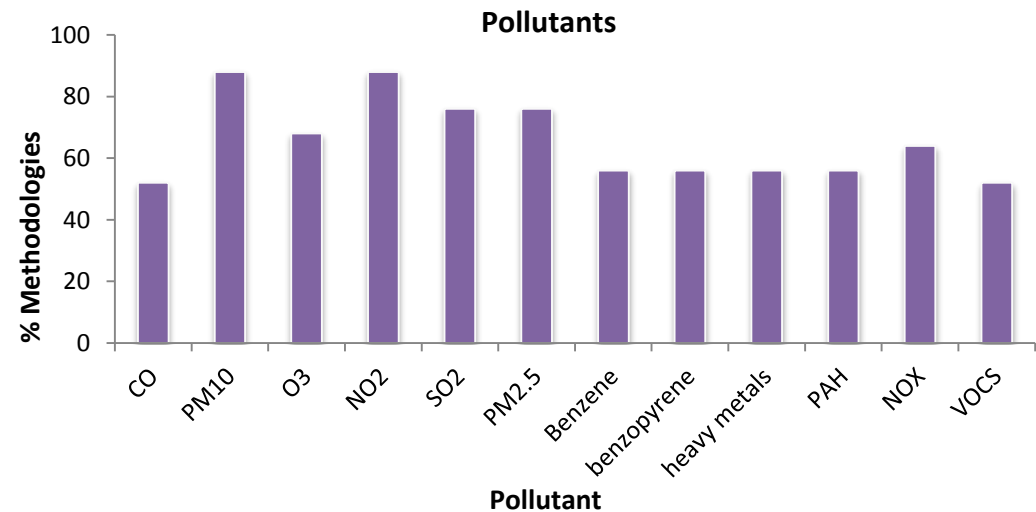
# Identification of methodologies

## Limitations :

### Pollutants requirements.

- Mostly no limitations
- However others are limited to the main pollutants of the legislation such as PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub>, O<sub>3</sub> and NO<sub>x</sub>/NO<sub>2</sub>.

Pollutants requirements	Number of methodologies	Number of methodologies interested to participate	Number of groups interested to participate
No limitation	15	13	12
Limited	4	4	3
No answer	6	3	3
<b>Total</b>	<b>25</b>	<b>20</b>	<b>18</b>



# Identification of methodologies

## Transferability to other region

Transferability of the method to other region	Number of methodologies	Number of methodologies interested to participate	Number of groups interested to participate
Yes	21	17	15
No	2	1	1
No answer	2	2	2
Total	25	20	18

# Identification of methodologies

## Transferability to synthetic datasets

Transferability of the method to synthetic datasets	Number of methodologies	Number of methodologies interested to participate	Number of groups interested to participate
Yes	16	14	12
No	6	3	3
No answer	3	3	3
<b>Total</b>	<b>25</b>	<b>20</b>	<b>18</b>

Group	Methodology					Scale		Output
	Models	Measure.	Proxies	Station classification	Others	Local/Urban	Regional	Maps
LANUV (Germany)	x	x	x	x	x	x	x	
Umweltbundesamt (Austria)	x	x	x			x	x	x
TNO (Netherlands)	x					x		x
VMM (Belgium)	x		x	x		x		x
ENEA (Italy)	x					x	x	x
			x			x	x	x
BSC (Spain)	x						x	x
			x				x	x
UA (Portugal)	x	x				x	x	x
IVU Umwelt GmbH (Germany)	x					x		x
RIVM (Netherlands)				x		x	x	x
CIEMAT (Spain)	x	x				x	x	x
Ricardo-AEA (UK)				x		x	x	
INERIS (France)	x	x				x	x	x
VITO (Belgium)			x			x	x	x
UPM (Spain)	x		x			x	x	x
FMI (Finland)				x			x	x
Helsinki RESA (Finland)	x	x	x	x	x			
Kuopio, REPS (Finland)	x	x	x			x	x	
Turku /ED (Finland)	x	x	x		x		x	
<b>TOTAL</b>	<b>14</b>	<b>8</b>	<b>10</b>	<b>6</b>	<b>3</b>	<b>15</b>	<b>16</b>	<b>15</b>

# Identification of methodologies

- Note that some groups use more than one method.
- There are a similar number of methodologies that can be applied to local/urban or to regional scale.
- Most of methodologies use models but the use of measurements, proxies and station classification is also relevant.
- Almost all groups provide maps for the SR areas, from which other parameters (such as areas, equivalent radius, etc) can be deduced.



# Description for Needed Shared Datasets

## Data required for the exercise:

- Air quality monitoring data,
- Data from sampling campaigns,
- Data from air quality modelling,
- Emission inventories,
- Meteorological and/or climatological data
- Other surrogate data:
  - land use/cover,
  - traffic intensities,
  - population density,
  - building geometries
  - topography .
- **This information should be available at local/urban and regional scale.**

# Description for Needed Shared Datasets

## Antwerp dataset:

- Modelling data from the whole city of Antwerp (about 25 km<sup>2</sup>??).
- Very high spatial (street-level) and temporal (hourly) resolution
- Main pollutants (PM<sub>10</sub>, Ozone and NO<sub>2</sub>),
- Local/urban scale.

# Description for Needed Shared Datasets

## Antwerp dataset. Available data:

- Results from a Gaussian dispersion model (IFDM)
- Contribution of all sources are calculated for each receptor point for every hour of a year.
- Hourly background concentration from a Chemical Transport Model (CTM) or spatial interpolation between measurement stations.
- Other data can be provided:
  - Point, line and surface emission sources from industry, traffic and domestic heating,
  - building geometry
  - meteorological data (temperature, wind speed and direction)
  - population density

# Description for Needed Shared Datasets

**Antwerp dataset. Other needed data (but not included) should be provided:**

- Land use data.
- Data for passive samplers at different locations in order to construct a map using interpolation. For these cases, some values from the concentration map of the shared data emulating virtual passive sampler data can be supplied to be used.
- Another important issue is to extend the exercise to regional scale with the same kind of data (concentration, meteorology, emissions, land use, topography, etc) but with a resolution in accordance with the spatial scale .

# How to compare the outputs of the different SR methods

- Different outputs from the different methodologies → difficult to compare them.
- Different types of comparison could be carried out.
- Most of the candidate methodologies provide concentration maps and SR maps:
  - Intermediate comparison of concentration maps.
  - Comparison of SR maps :
    - Without taking into account the different criteria for estimating SR.
    - Defining a unique SR criterion for all methodologies and use it in the intercomparison.
- The comparison of maps can be done by estimating the intersection of the SR maps computed by the different methodologies.

# How to compare the outputs of the different SR methods

- Other methodologies provide simplified description of SR.
  - Comparison of features of the SR such as areas, sizes or equivalent radius (obtained sometimes from SR maps)
- Some problems for the few methodologies providing only qualitative description of the SR. Is the qualitative description compatible with the SR maps?
- In preparation step of the intercomparison exercise, more discussion is needed to reach an agreement on how to compare the outputs.

# Proposal of intercomparison exercise

- Different SR definitions, different methodologies for estimating SR areas and different types of inputs and outputs.
- Same SR definition can be used for different methodologies and a same methodology can be used for different SR definitions .
- Recommendable **to find a prior agreement about the definition of SR** and to compare only outputs from methods sharing the same definition → limit the participation of groups.

# Proposal of intercomparison exercise

- We propose an **open concept** → As many methodologies as possible should participate in the exercise providing their estimates of SR areas.
- However, the statistical intercomparison should be done for the outputs of:
  - All the methodologies. Interesting for analysing the similarity of SR maps provided by different methodologies or SR definitions → different definitions or methodologies are equivalent or not in terms of their results?
  - For subgroups corresponding to outputs of similar methodologies or similar SR definitions. Interesting for analysing the variability in the SR area estimates obtained from similar methodologies or definitions respect to those resulting from different methodologies or definitions.



# Proposal of SR intercomparison exercise

- The intercomparison exercise should consist of two different scales:
  - Local-urban scale for NO<sub>2</sub> and PM10.
  - Regional scale for NO<sub>2</sub>, O<sub>3</sub> and PM10 .
- The results could be based on annual metrics of concentrations such as average or percentiles (related to limit or target values) from daily or hourly input values.
- Hourly or daily input data (time series) could be necessary for some methodologies which are based on the similarity of concentrations during a time period,

# Proposal of SR intercomparison exercise

## Required input data (with a resolution according with the spatial scale):

- Air quality data :
  - monitoring, mainly from networks of air quality monitoring stations.
  - sampling campaigns, with passive samplers or mobile stations.
  - modelling. Many groups use their own model results and they will not need modelling data as input. But maybe, it can be useful for some other groups as an additional input for their methodologies.
- Other input data for modelling:
  - emission inventories, (gridded data, point and line sources).
  - meteorological or/and climatological data, mainly wind (speed and direction), temperature and precipitation from stations or from meteorological models
- Surrogate data:
  - land use/cover, CORINE Land Cover database is used by several groups,
  - traffic intensities,
  - population density,
  - building geometries
  - topography.
  - Emission data. Some groups use this information as proxies of their methodologies

# Proposal of SR intercomparison exercise

- The outputs to be compared should be:
  - SR maps.
    - An agreement on the geographical projection and file formats should be necessary.
    - Comparison can be based on analysing the intersection of the maps.
  - Areas, sizes or equivalent radius of the SR.
  - Concentrations fields computed by the air quality models used in the exercises → intermediate intercomparison in order to gain more insight about the causes of the differences in the SR maps.

# Proposal of SR intercomparison exercise

- How many stations for the intercomparison exercise?
  - To take into account the computational burden for modelling for CFD or CTM models
  - We suggest one or two stations for each scale of different type.

# Conclusions

- We recommend an open exercise in order to as many participants and methodologies as possible can participate.
- 18 groups intend to participate with 20 methodologies.
- We think that the intercomparison exercise can be feasible with Antwerp dataset but more data are needed.
- We propose an exercise covering : local/urban (NO<sub>2</sub> and/or PM10) and regional (NO<sub>2</sub> and/or PM10 and O<sub>3</sub>). At least, one traffic and two urban background stations?
- Some additional data are needed (land use)
- Synthetic data simulating virtual measurement campaigns?
- Data for regional scale?
- Comparison based mainly on SR maps and features of SR (areas, radius, etc)
- Comparison:
  - All methodologies
  - Groups of methodologies.
- Details has to be discussed and agreed in the next step for the design of the intercomparison exercise.

# Discussion