Spatial Representativeness of Air Quality Monitoring Stations:
Status of the Intercomparison Exercise

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With contributed information from
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FAIRMODE
Forum for air quality modelling in Europe

Fairmode Plenary Meeting
16th and 17th February 2016
Baveno - Italy

Joint Research Centre

IC Exercise

Outline

- Scope and Objectives of the Intercomparison Exercise
- Timeline and Progression
- Participation
- Datasets
- Treatment of Results
- Possible extension to Station Classification (suggestion)

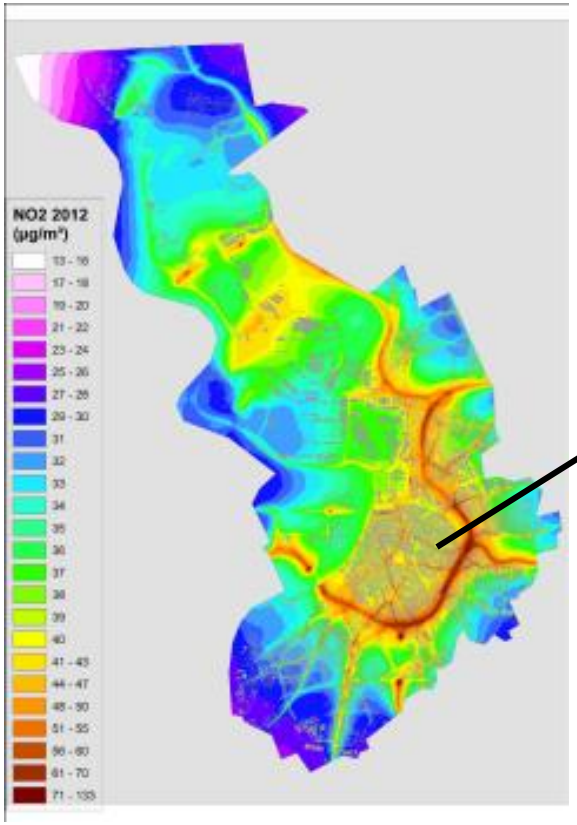
Work Plan and Objective

The **intercomparison exercise** on spatial representativeness (SR) methods shall:

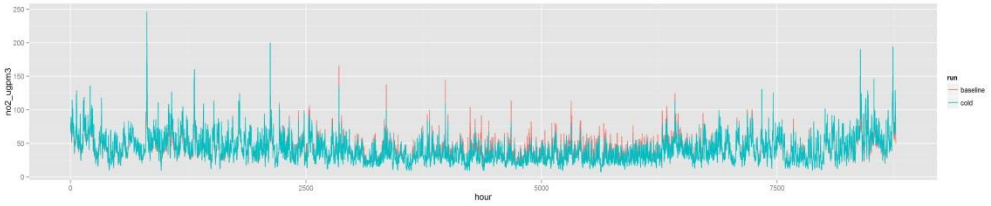
- Be **executed by different groups**, but on the same **shared dataset**.
- Cover as much as possible the total **variety and diversity of procedures which are in use today** - ranging from methods with moderate complexity, used for pragmatic purposes, to those which involve higher levels of data requirements and computational efforts.

Use of Shared Datasets

Example: 2012 IFDM Model results for Antwerp

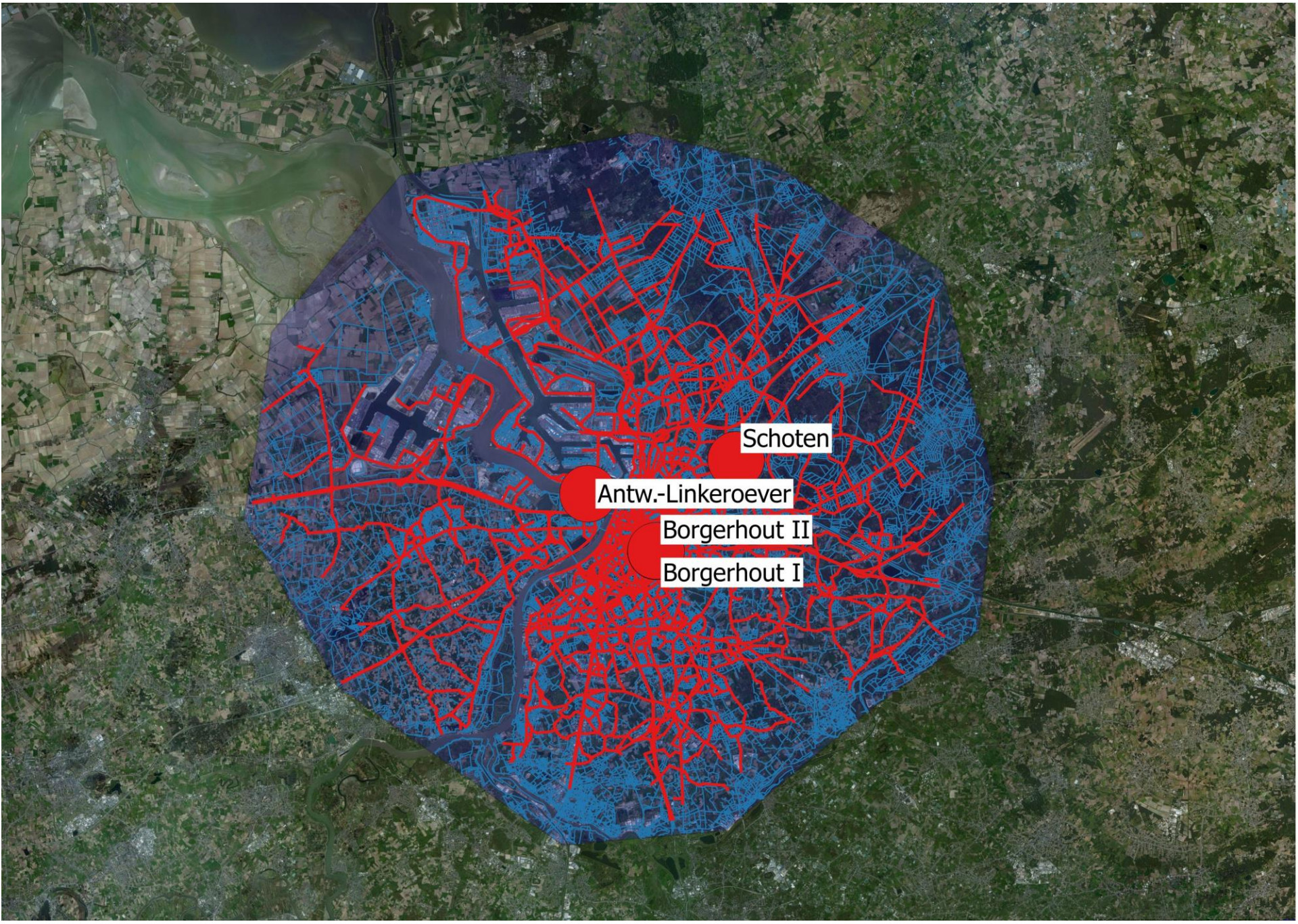


- Annual average concentration, res≈20m (irregular grid)
- Hourly time series on previously specified points, e.g. monitoring stations, virtual sampler positions.



Application Site and Monitoring Stations

- Modelled concentration obtained from the RIO-IFDM-OSPM model chain for the region of Antwerp
- Spatial Representativeness estimation for the year 2012:
  - for PM_{10} and NO_2 at one traffic station
  - for PM_{10}, NO_2 and O_3 at two urban background stations


Schoten
Antw.-Linkeroever
Borgerhout II
Borgerhout I

A) Progression & Past Dates

Jan. / Feb. 2015

- Distribution of questionnaires for the feasibility study

Feb. 2015

- FAIRMODE Plenary Meeting in Baveno (IT)
  - Presentation of the survey and of first outcomes

June 2015 & FAIRMODE Technical Meeting

- Final reporting on the results of the feasibility study
  - Identification of candidate methods and possible participants
  - Detailed discussion on means and operation (datasets, timeframe…)

since Nov. 2015

- Definition of datasets (selected for the city of Antwerp)

since Jan. 2016

- Preparation of AQM simulations to be performed by VITO

B) Future Dates

Feb. 2016

- Simulations based on the RIO-IFDM-OSPM model chain
  - Done by VITO (W. Lefebvre, H. Hooyberghs, S. Janssen, B. Maiheu)

April 2016

- Inspection of datasets by JRC

May 2016 (tentative)

- Official distribution of datasets
  - Datasets to be made available to participants for download from the FAIRMODE homepage

Summer 2016

- FAIRMODE Technical Meeting
  - Possibility to discuss and answer questions on technical details, means and operation (datasets, timeframe …)

Sept. 2016 (tentative)

- Return of the SR results provided by participants
  - Uploading facility made available on FAIRMODE homepage

IC Exercise Participation

Country	Institution	
Austria	Umweltbundesamt Austria	
Belgium	Flemish Environment Agency (VMM)	
Belgium	VITO	
Finland	Finnish Meteorological Institute	
Finland	Helsinki Region Environmental Services Authority	
Finland	City of Kuopio / Regional Environmental Protection Services	
Finland	City of Turku / Environmental Division	
France	INERIS	
Germany	LANUV, FB 42	**awaiting reply**
Germany	IVU Umwelt GmbH	**awaiting reply**
Ireland	Irish EPA	
Italy	ENEA	some reservations (gridded data)
Netherland	TNO	
Netherland	National Institute for Public Health and the Environment	**awaiting reply**
Spain	Barcelona Supercomputing Center	
Spain	CIEMAT	
Spain	Technical University of Madrid (UPM)	
Sweden	Swedish Meteorological and Hydrological Institute	
UK	Ricardo-AEA	classification / source apportionment needed
	JRC	
total =	20	

Datasets to be made available

Datasets to be made available (1)

Measurements of the Antwerp monitoring stations

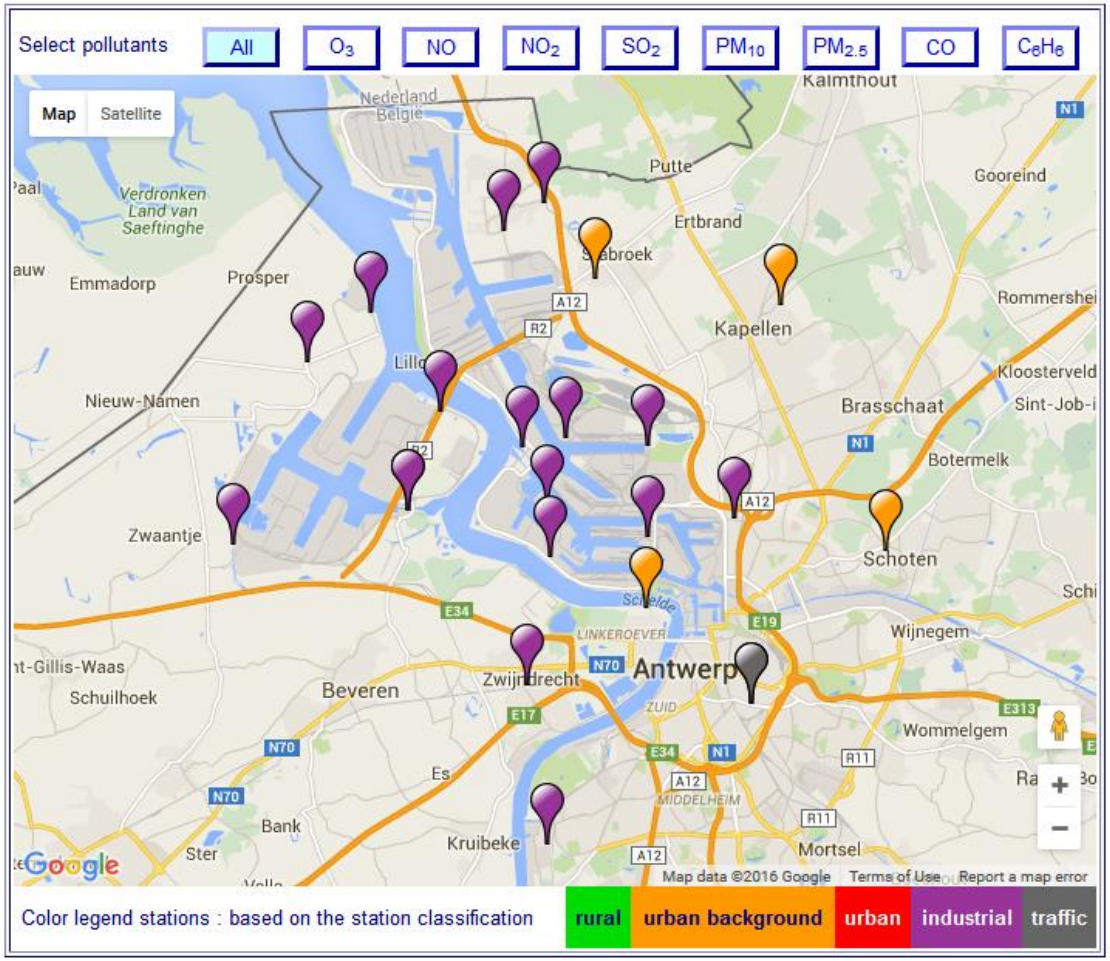
- Automatic network for the city of Antwerp and its regional area (23 sites).
- All available compounds shall be included.
  - $PM_{2.5}$, PM_{10}, O_3, $NO/NO_2/NO_x$, CO, SO_2
  - BTX and available VOCs
  - Two averaging times (hourly and yearly)
- The official classification of these stations should also be supplied

IC Exercise

European Commission

Datasets

Antwerp monitoring stations



http://www.irceline.be

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Datasets to be made available (2)

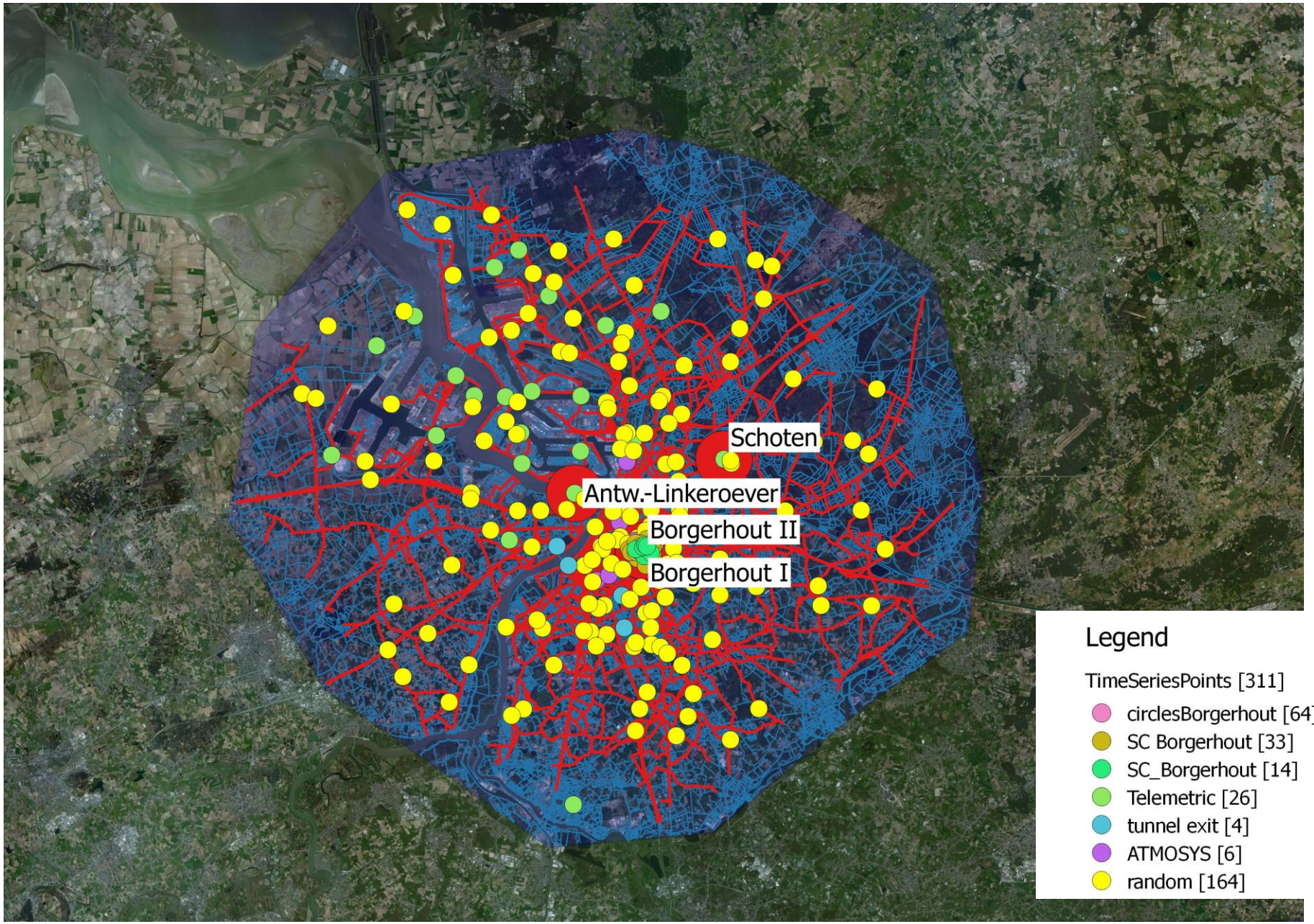
Auxiliary measurements from sampling campaigns (passive samplers and mobile stations)

- PM_{10} and chemical speciation
  - daily averages of taken every 4th day at 3 sites
- NO_2
  - 2-week averages taken at 6 sites

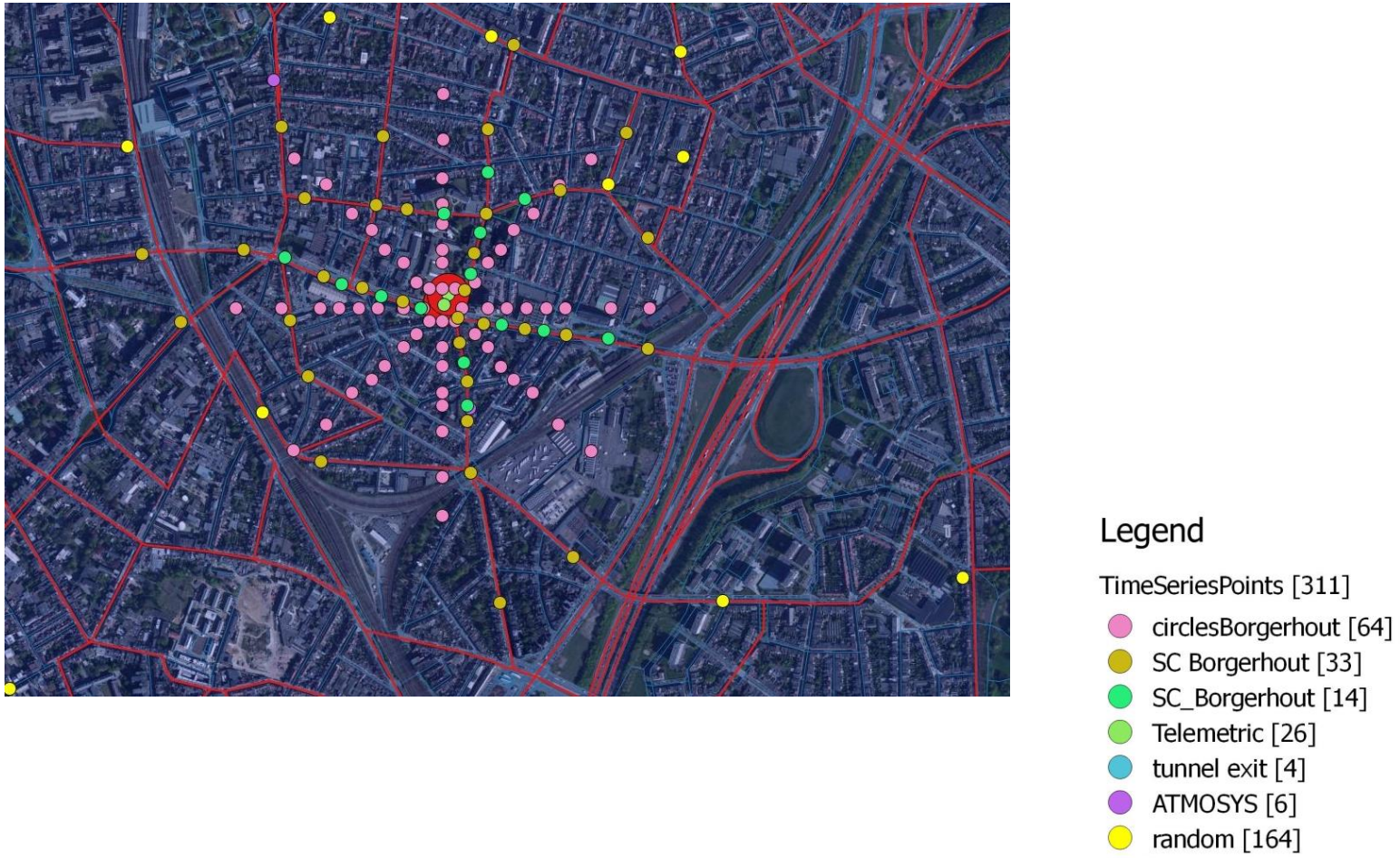
(3) Modelled concentration obtained from the RIO-IFDM-OSPM simulations

- Gridded model data
  - $PM_{2.5}$, PM_{10}, O_3 and NO_2
  - Annual averages on a regular grid (probably at 10m resolution)
- Virtual monitoring points
  - Ca 340 points at traffic sites and at urban background locations
  - $PM_{2.5}$, PM_{10}: daily and annual averages
  - O_3 and NO_2: hourly and annual averages
  - Daily and hourly data **not** visible to participants? **(to be discussed)**
- Virtual diffusive samplers
  - Ca 340 synthetic series generated from the virtual monitoring points
  - Integration time of 2 weeks (1 week or 4 weeks if this would be required)
  - Added random noise corresponding to the data quality objectives for indicative measurements

Virtual Monitoring Points



More dense pattern of virtual monitoring points around the traffic station



Datasets to be made available (4)

Emission datasets

- Gridded emissions at 1x1km²
  - $PM_{2.5}$, PM_{10}, NO_x, NH_3, NMVOCs, CO, SO_2
  - Split up into different SNAP-sectors + total of all sectors

Additionally downscaled emission information:

- Traffic emissions at 1x1km²
  - Annual average emissions per line segment of roads
  - Annual average traffic per line segment
- Point sources
  - Point sources reported by Belgian authorities in the scope of the CLRTAP Convention on Long-range Transboundary Air Pollution
  - Annual totals for 2010

Datasets to be made available (5)

Auxiliary datasets

- Population density for the great Antwerp area
  - gridded on a 100x100 m² grid
- Cadaster of building height
  - gridded on a 100x100 m² grid
- CORINE land use data
  - CORINE land cover classification (CLC2012)
  - gridded on a 100x100 m² grid

Datasets: some remarks

It should be noted that the concentration data obtained from the three major types of sources

- Measurements of the Antwerp monitoring stations
- Auxiliary measurements from sampling campaigns
- Modeled concentration from RIO-IFDM-OSPM

are **not** corrected for bias.

Datasets: Remarks

Visibility of all simulation data to all participants?

- Virtual Monitoring Points (hourly or daily data): **"hidden" ?**
- Virtual Diffusive Samplers (2 weeks integration time): **"visible"**
- Prior knowledge of station classification: **"visible"**

We propose that all data will be made available to everybody, but participants are asked to state later which data they have used.

How to compare the results?

How to compare the results?

We anticipate a **certain variety** of different types of outputs:

- Most candidate methodologies provide maps of the SR area.
- Other methodologies provide more simplified descriptions (attributes) of SR areas and / or are linked to station classification.
- Few methodologies might give only qualitative descriptions of the SR area.

Output Data	Number of Methodologies
Maps	18
Simplified metrics	11
Scale	9
Similarity of locations	6
Spatial variance	1
Other statistical means	3
Others	5
No answer	3
total	*25 methods from 22 groups*

Comparison of the results

- Comparisons based on estimating the intersection of SR maps
  - Area of overlapping / non-overlapping polygons
  - Probably to be weighted with population density
- Comparing other attributes of the SR area, such as total sizes or equivalent radii.
- For qualitative descriptions: analyse whether these descriptions are compatible with the maps obtained from other methodologies.
- Comparing the concentration maps derived in intermediate steps could be an additional option.

Comparison between SR Estimates	Suggested by x Methodologies
Comparing maps of SR	13
Comparing attributes of SR	10
Comparing areas of exceedances	2
No answer	11
total	*25 methods from 22 groups*

Should the exercise be extended to reporting a statement about station classification?

- To be discussed.
  - We propose to open this possibility to those participants who would like to (with no obligation for the others)
  - We need a minimum number of participants
  - Please feedback
- Can this be seen feasible for the full set of ca 340 virtual stations (automatic processing?) or should a reduced set be defined?
  - We consider that a combined setting of tasks ((a) full set of 340 points, plus (b) reduced set for those who cannot report on such a high number) could be most useful.

Thank you for your attention!

Questions and Suggestions?