WG1 DISCUSSIONS ON "FITNESS FOR PURPOSE"
FAIRMODE TECHNICAL MEETING ATHENS 2017

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vito

QUESTION 1

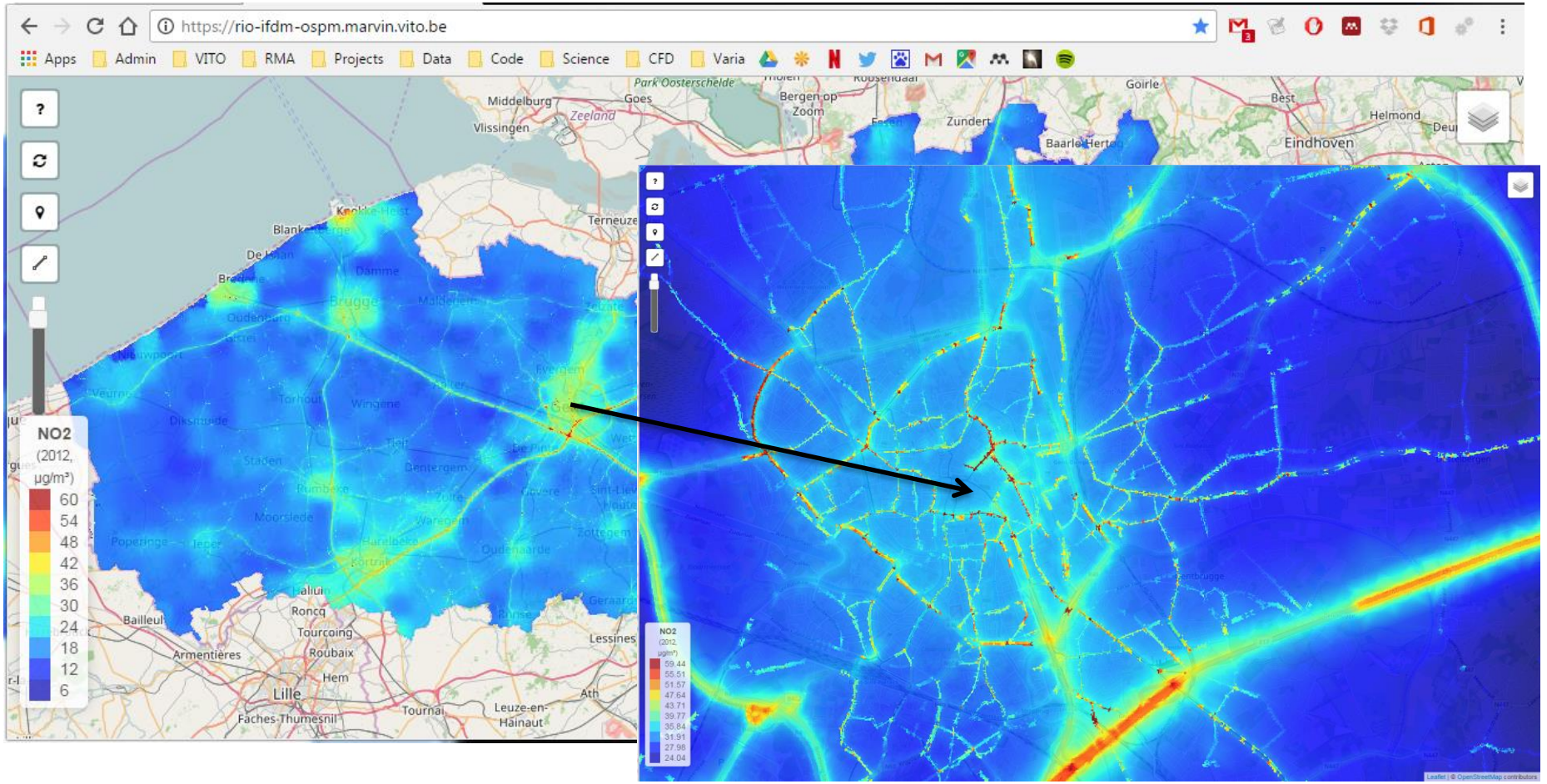
QUESTION 1

Do you see (other) elements that define the extent of a model's fitness-for-purpose with regard to exposure assessment ?

- Yes,
- Some food for thought :
  - Exposure is not the same purpose as exceedance assessment
  - Model type vs. application

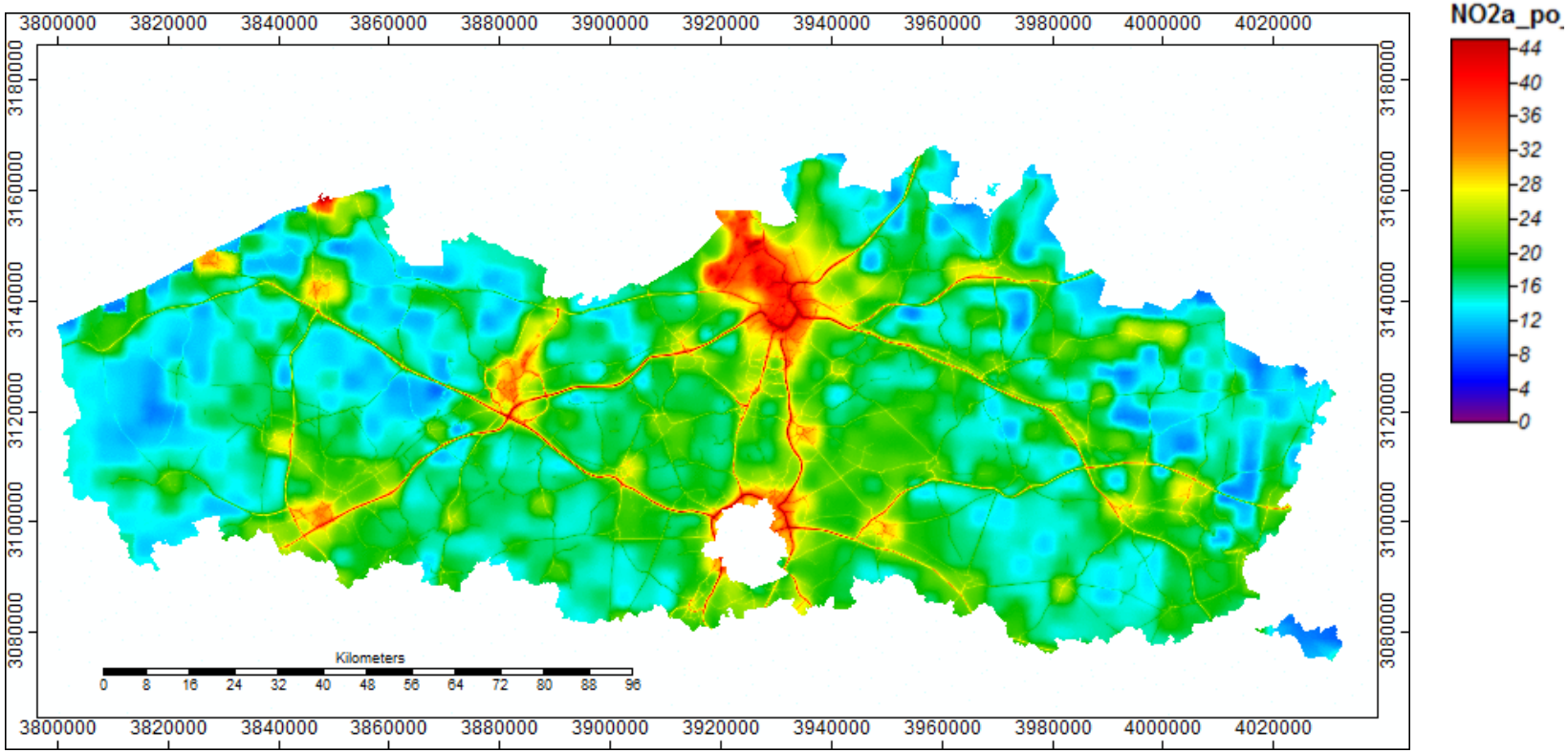
QUESTION 1

ATMOSYS AQ assessment for Flanders, including street canyon parametrisation (OSPM)



QUESTION 1

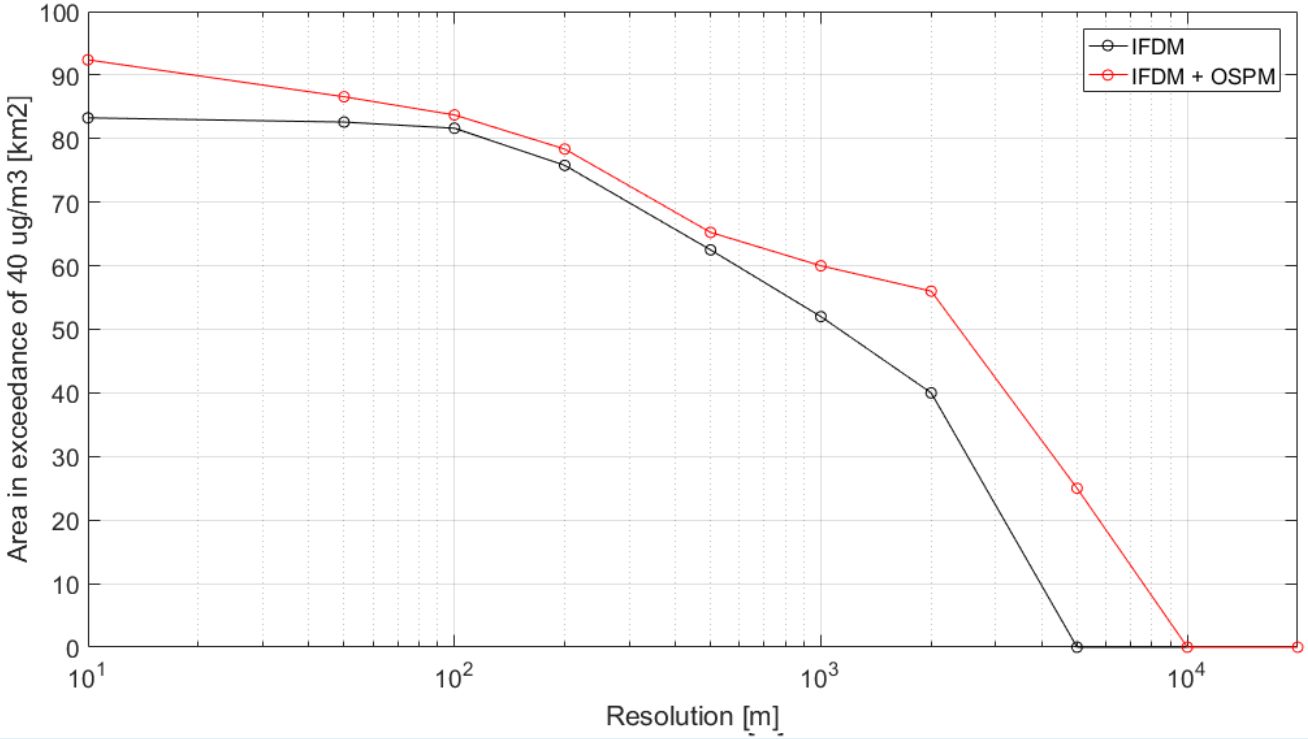
Resolution degradation



QUESTION 1

Importance of spatial scale

- Spatial scale degrading (simple averaging) 10 m → 20 km shows dramatic decrease in area in exceedance
- Importance of steet canyon effects increases with spatial scale



Voettekst invulling

QUESTION 1

Issue of spatial scale

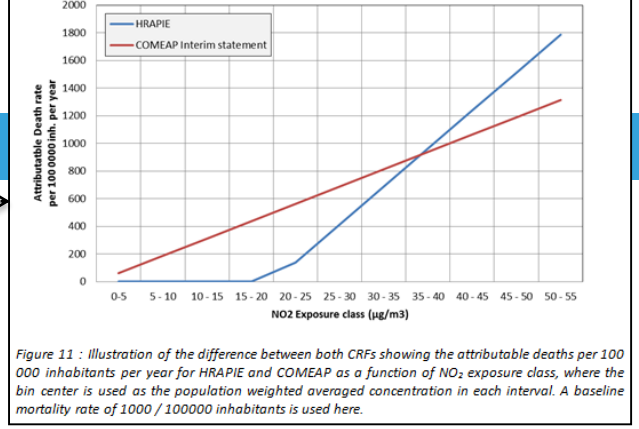
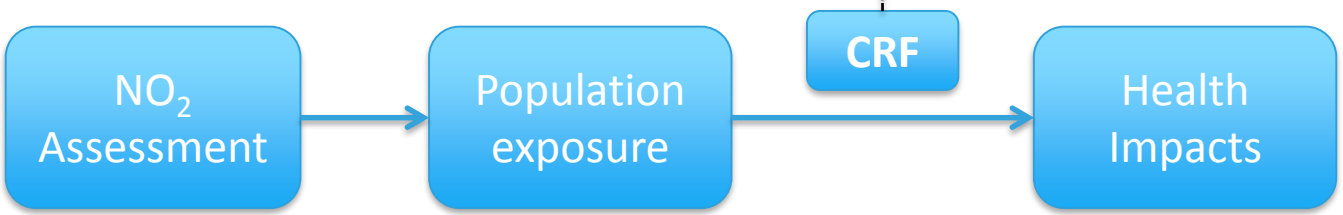


Figure 11 : Illustration of the difference between both CRFs showing the attributable deaths per 100 000 inhabitants per year for HRAPIE and COMEAP as a function of NO_2 exposure class, where the bin center is used as the population weighted averaged concentration in each interval. A baseline mortality rate of 1000 / 100000 inhabitants is used here.

- Fitness for purpose for exposure modelling
- Health impacts : RR



- How CRF's are derived
  - Epidemiological studies (cohort studies)
    - Spatial metrics as **surrogates** for personal exposure
    - Often using LUR
    - Spatial scale → **compatibility required**, otherwise Biases in health impacts…
  - Meta analyses
    - Spatial scale ?

- Chicken or the egg : dynamic vs. static exposure
- Dialog with epi-community required, FAIRMODE cannot tackle this alone…

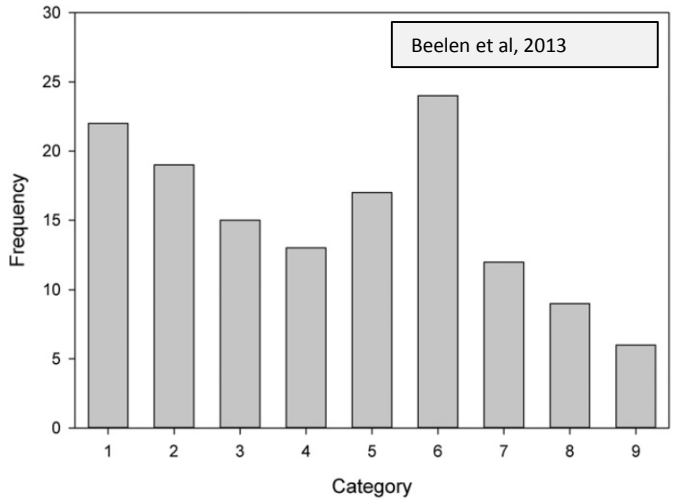
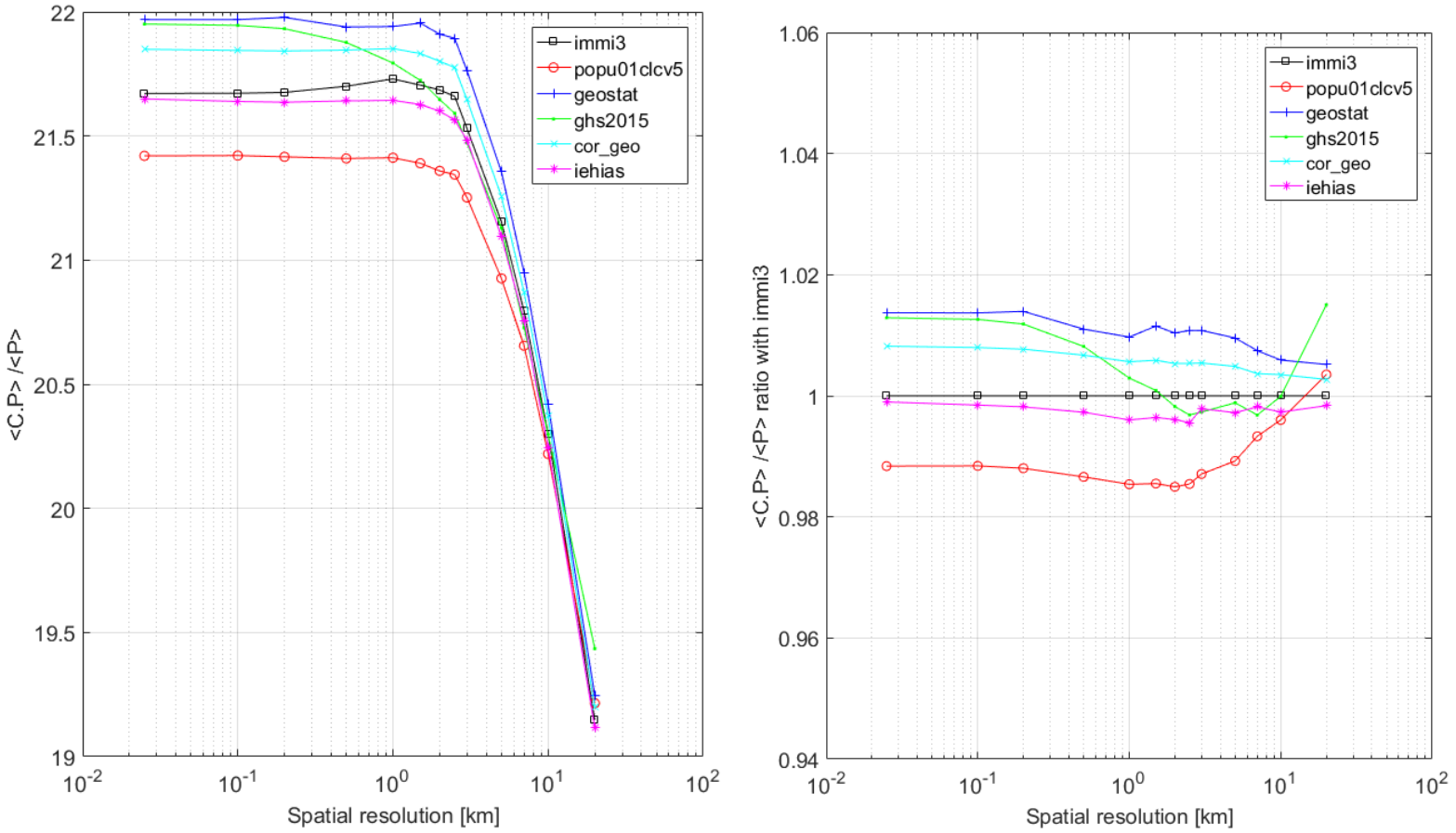


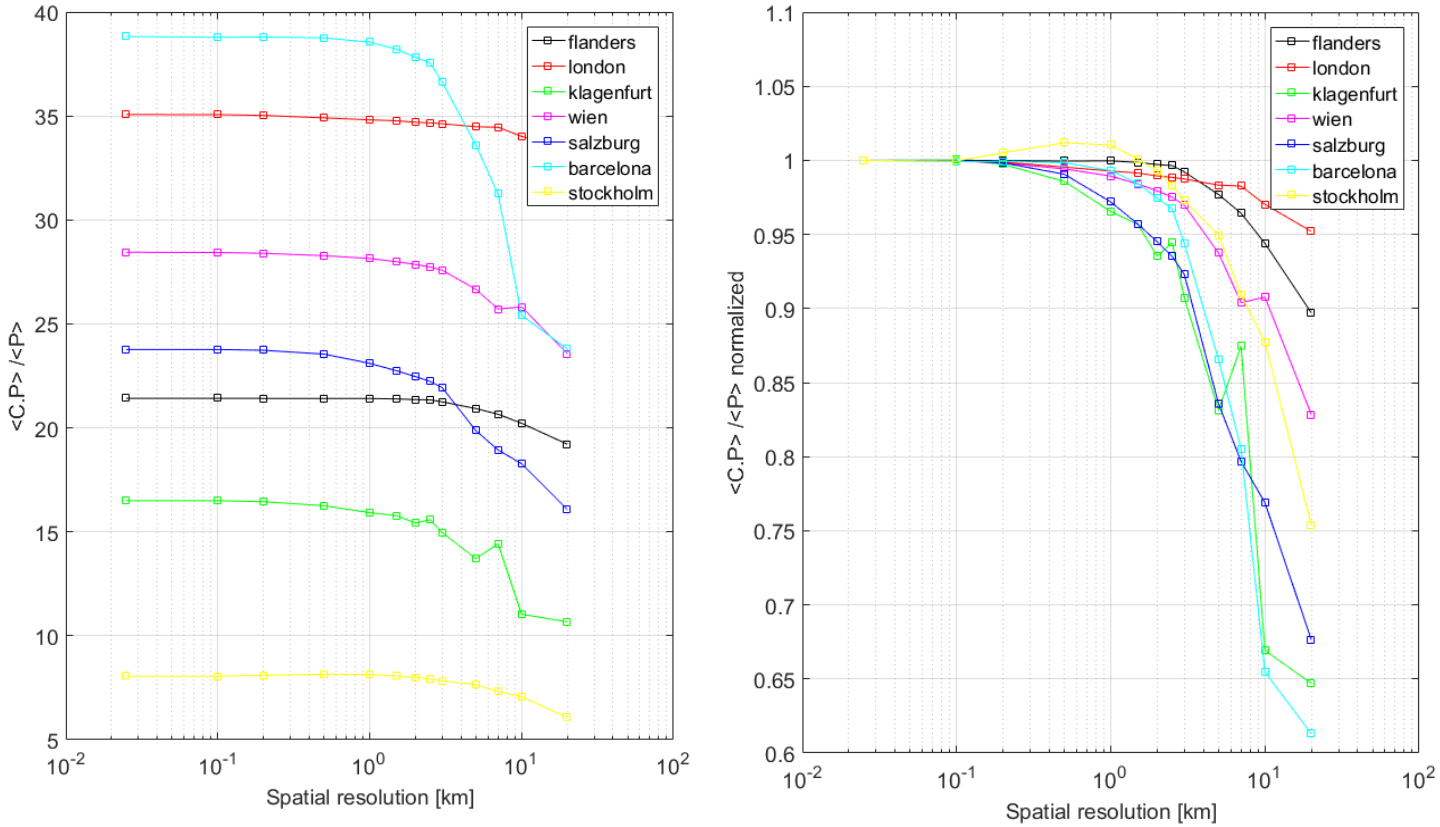
Fig. 3. Frequency of categories of included predictor variables in NO_2 LUR models over all study areas. Traffic variables: 1 = Traffic intensity =< 100 m (All traffic intensity variables with buffer size = <100 m, including traffic intensity on nearest and nearest major road); 2 = Road length = <100 m; 3 = Traffic intensity > 100 m; 4 = Road length > 100 m; 5 = Distance to traffic/road (All variables with distance to a road or traffic, including variables with product of traffic intensity and distance); and Background variables: 6 = Population/buildings/residential land/household density; 7 = Natural land/green space; 8 = Industry/port; and 9 = Other.

Population weighted concentrations…



- Source : VITO, under EC DG-ENV Service Contract 070201/2015/SER/717473/C.3

Population weighted concentraions…

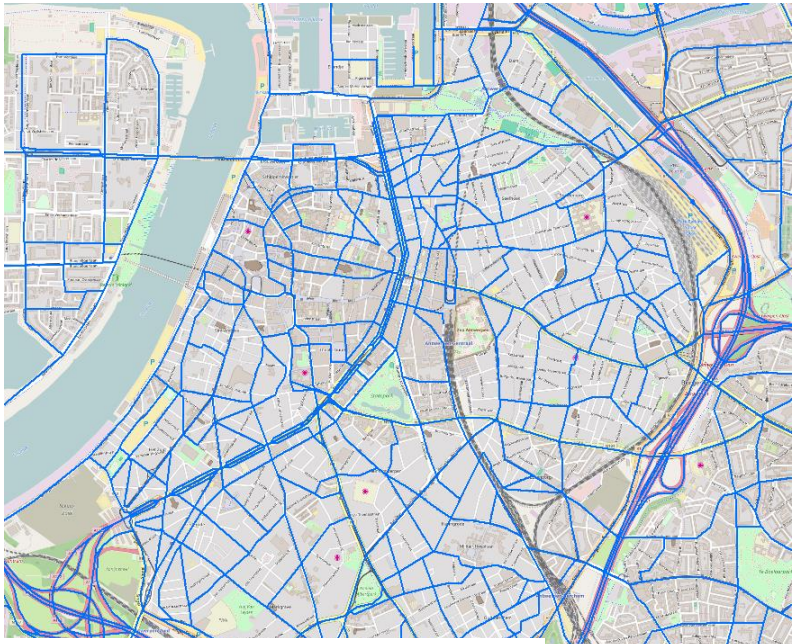


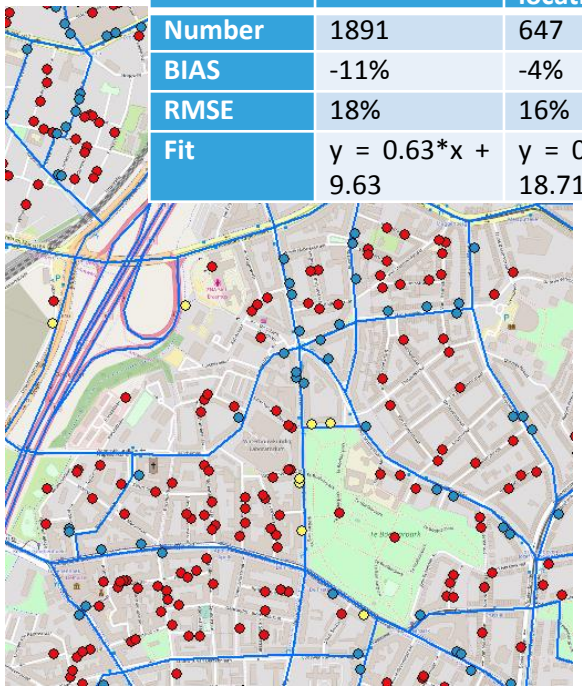
- Source : VITO, under EC DG-ENV Service Contract 070201/2015/SER/717473/C.3

QUESTION 1

What is model resolution ?

- AQ model scale is not necessarily the same as spatial resolution
  - E.g. level of detail of available traffic data or urban detail !





	All points	OSPM locations	Other locations
Number	1891	647	1181
BIAS	-11%	-4%	-13%
RMSE	18%	16%	17%
Fit	y = 0.63*x + 9.63	y = 0.49*x + 18.71	y = 0.55*x + 10.74

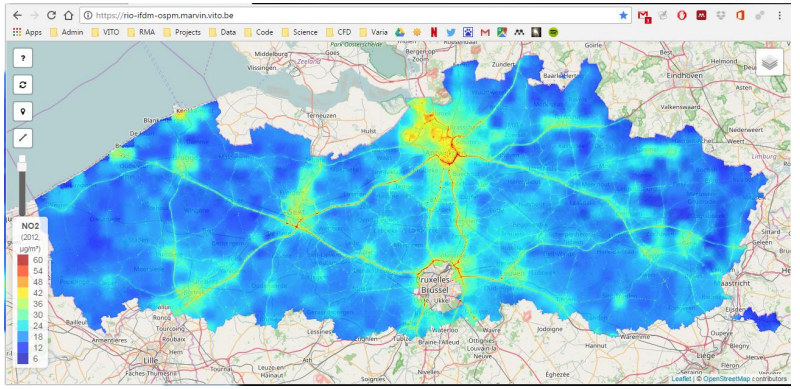
Region Antwerpen:

~ 50% roads is missing w.r.t. AGIV / OSM

QUESTION 1

Fitness for purpose : model type, criterion matrix ?

- Different model applications : assessment vs. scenario calculation
- Criteria :
  - Spatial scale
  - Spatial coverage
  - Temporal scale
  - Data availability
  - …



- vs

- Different model types : e.g. LUR vs. dispersion modelling

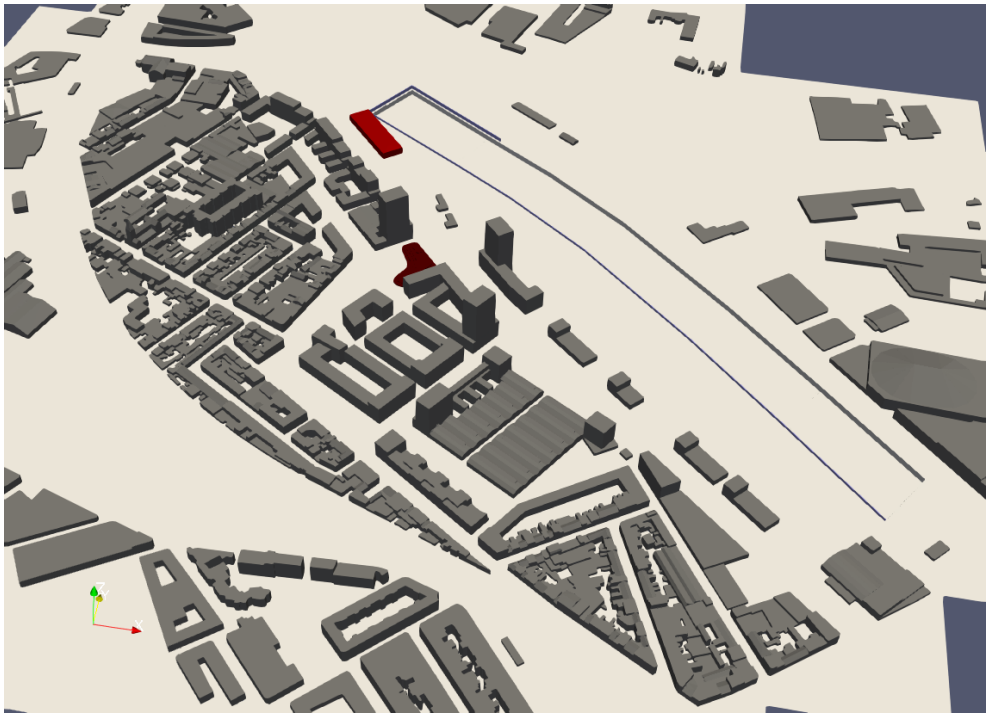
- Deal with sensitivities w.r.t. model type → dialog
  - E.g. Can LUR's be applied for scenario assessments
  - Applicability of street box models for complex situations

QUESTION 2

QUESTION 2

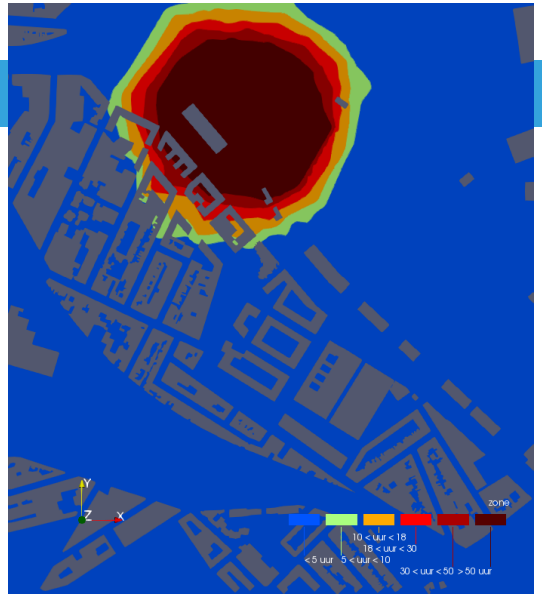
Do you agree that assessment/definition of the typical spatial variability is one of the main missing criteria to define fitness-for-purpose within the present FAIRMODE concepts?

- Yes !
- However:
  - Should not overlook temporal variability !
  - Can we use annual averaged models to say something about PM_{10} daily limit, NO_2 hourly limit ?
    - Relationship between PM_{10} annual average & # days PM_{10} > 50 µg/m^3 (e.g. RLB Flanders : 31.3 PM_{10} annual avg = 35 days (Celis et al, 2013)
    - Less obvious for NO_2 hourly limit… (# hours NO_2 > 200 µg/m^3)
  - Sometimes fitness for purpose has to be argmented in policy context (IEA regulations)



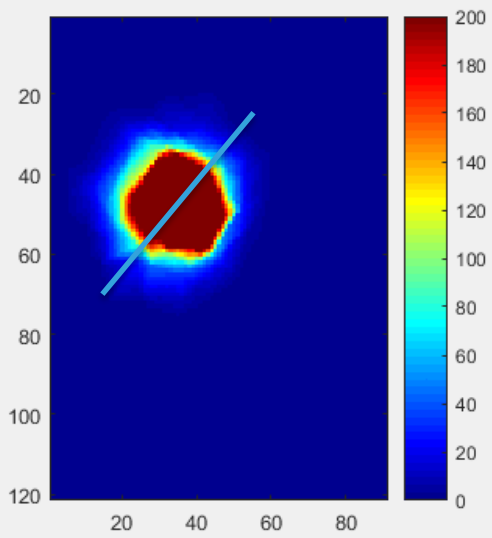
QUESTION 2

Example from practise…

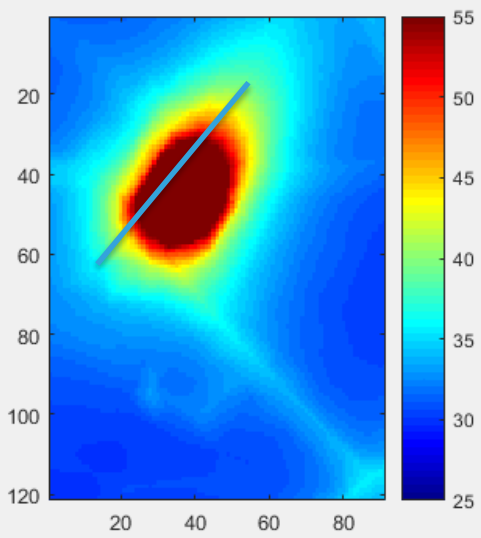


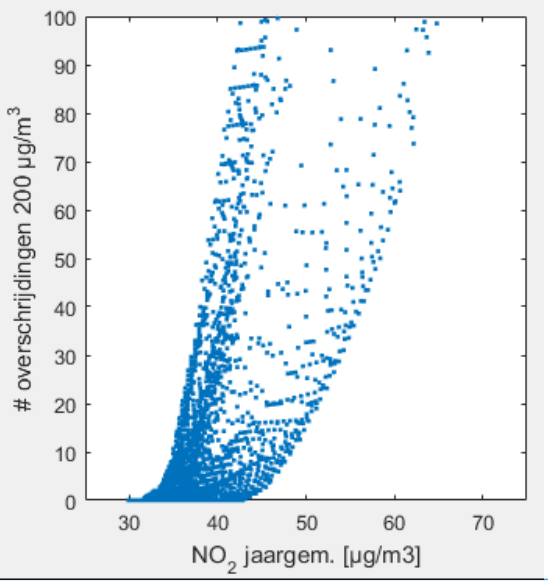
- Complex relation between annual NO_2 & # exceedances
- Annual averaged model not generally suitable to test NO_2 hourly norm

exceedances



Annual avg NO_2





Health effects

- Also some health effects are related to short term exposure, though less important than links with long term exposure (annual averaged NO_2)

POLLUTANT METRIC	HEALTH OUTCOME	GROUP	RR (95% CI) PER 10 µg/m³	RANGE OF CONCENTRATION	SOURCE OF BACKGROUND HEALTH DATA	SOURCE OF CRF	COMMENTS
NO_2, daily maximum 1-hour mean	Mortality, all (natural) causes, all ages	A*	1.0027 (1.0016–1.0038)	All	MDB (World Health Organization, 2013c), rates for deaths from all natural causes (ICD-10 chapters I–XVIII, codes A–R) in each of the 53 countries of the WHO European Region, latest available data	Air Pollution and Health: a European Approach (APHEA)-2 project with data from 30 European cities; RR adjusted for PM10	
NO_2, daily maximum 1-hour mean	Hospital admissions, respiratory diseases, all ages	A	1.0015 (0.9992–1.0038)	All	European hospital morbidity database (World Health Organization, 2013d), ICD-9 codes 460– 519; ICD-10 codes J00– J99	APED meta-analysis of four studies published before 2006; coefficient from single-pollutant model. WHO (2013a) noted that the estimates for this pollutant–outcome pair were robust to adjustment to co-pollutants.	Alternative to the estimates based on 24- hour NO_2 average (preferred due to availability of more studies)
NO_2, 24-hour mean	Hospital admissions, respiratory diseases, all ages	A*	1.0180 (1.0115–1.0245)	All	European hospital morbidity database (World Health Organization, 2013d), ICD-9 codes 460– 519; ICD-10 codes J00– J99	APED meta-analysis of 15 studies published before 2006; coefficient from single-pollutant model. WHO (2013a) noted that the estimates for this pollutant–outcome pair were robust to adjustment to co-pollutants	

- Group A: pollutant–outcome pairs for which enough data are available to enable reliable quantification of effects;
- Group B: pollutant–outcome pairs for which there is more uncertainty about the precision of the data used for quantification of effects

Pollutant–outcome pairs marked with an asterisk (*) contribute to the total effect (i.e. the effects are additive) of either the limited set (Group A*) or the extended set (Group B*) of effects. Calculation of the range of overall costs and benefits should be based on the following principles:

- the calculation of a limited set of impacts based on the sum (Σ) of Group A*;
- the range of uncertainty around the limited estimate, from Σ minimum (Group A*, Group A) to Σ maximum (Group A*, Group A), possibly combined with Monte Carlo estimates based on confidence intervals (CIs) of RRs – minimum/maximum functions select smaller/larger effect in the related alternative options;
- the calculation of an extended set of impacts based on Σ Group A* + Σ Group B*;
- the range of uncertainty around the extended estimate, from Σ [minimum (Group A*, Group A) + minimum (Group B*, Group B)] to Σ [maximum (Group A*, Group A) + maximum (Group B*, Group B)], possibly combined with Monte Carlo estimates based on CIs of RRs.

RR Relative risk; MDB Mortality database; ICD International Classification of Diseases; APED St. George's Air Pollution Epidemiology Database

H. Walton, KCL

Voettekst invulling

QUESTION 3

QUESTION 3

Do you have any preferences or suggestions on how to define the typical spatial variability for the yearly average environmental criteria for NO_2 and $PM_{2.5}$ (first focus)?

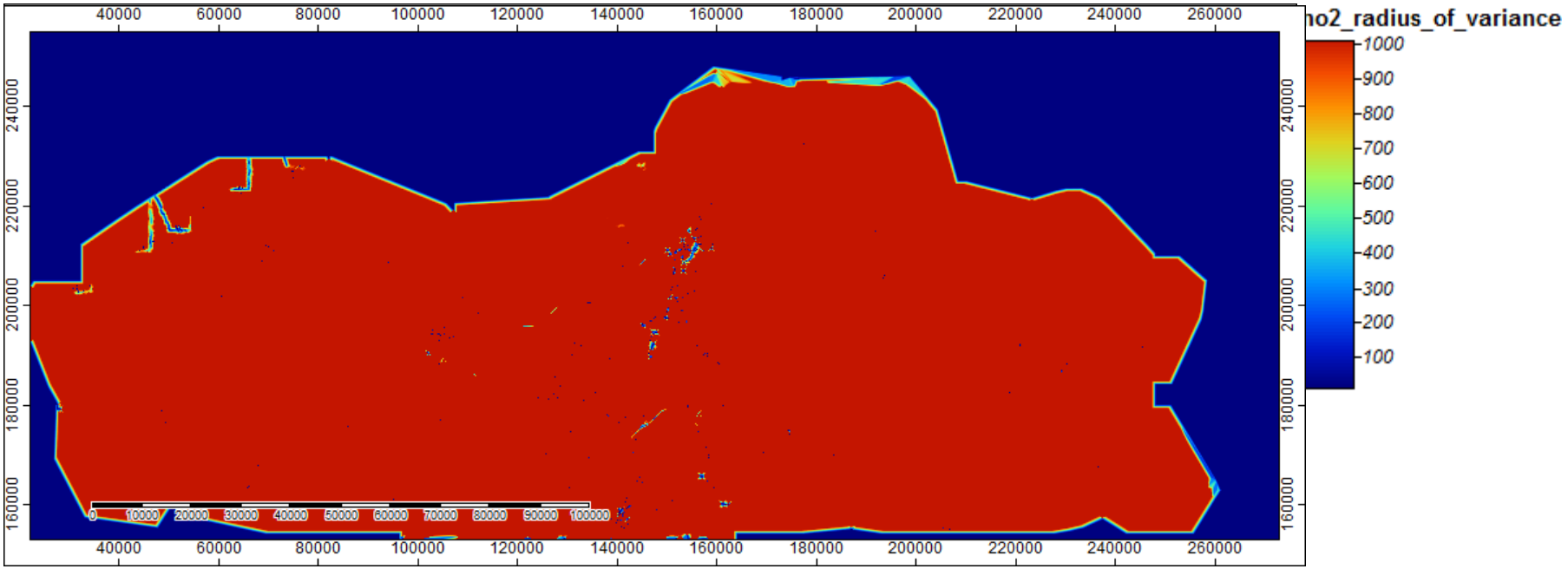
- Obvious link to spatial representativeness
- Look at highest resolution data
  - Learn from extensive measurement campaigns
  - Sensor networks
  - Perhaps also CFD dispersion models

- Spatial metrics to define spatial structure ?
  - Radius of variance ?
  - Semi-variogram ?
  - …

QUESTION 4

Need for spatial metric

- Radius around given point where standarddeviation stays < 1 µg/m3.
- NO_2, vs $PM_{2.5}$

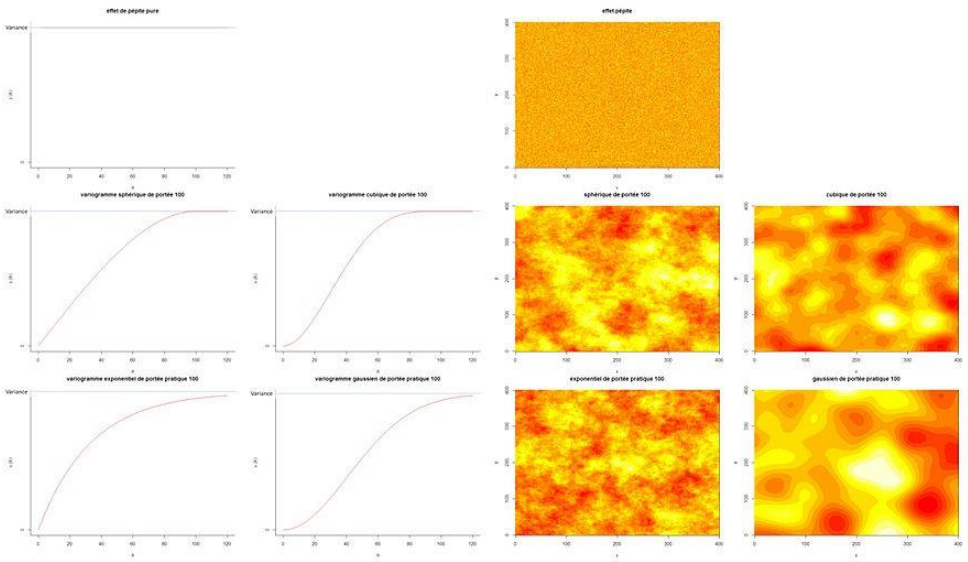


QUESTION 4

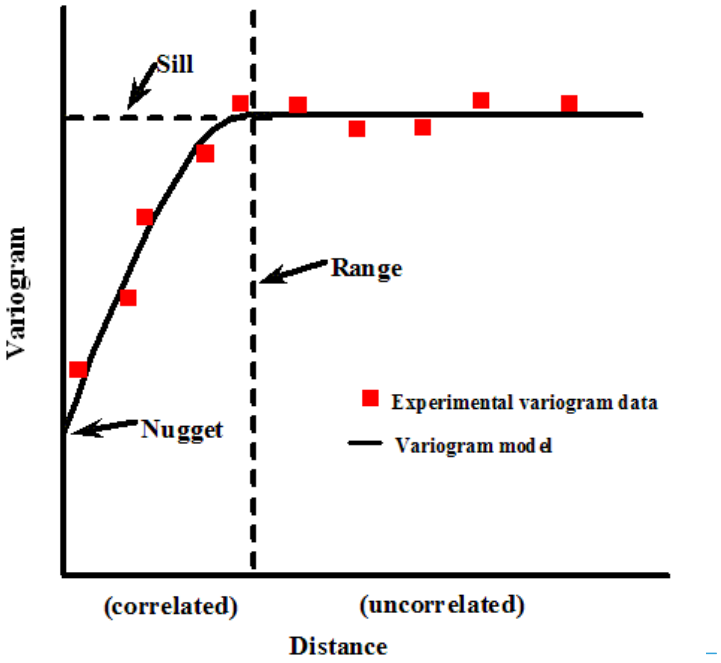
Spatial metric

- Study semi-variograms for concentration maps ?

$$\gamma(h) = \frac{1}{2N(h)} \sum_{i=1}^{N(h)} [Z(x_i + h) - Z(x_i)]^2$$

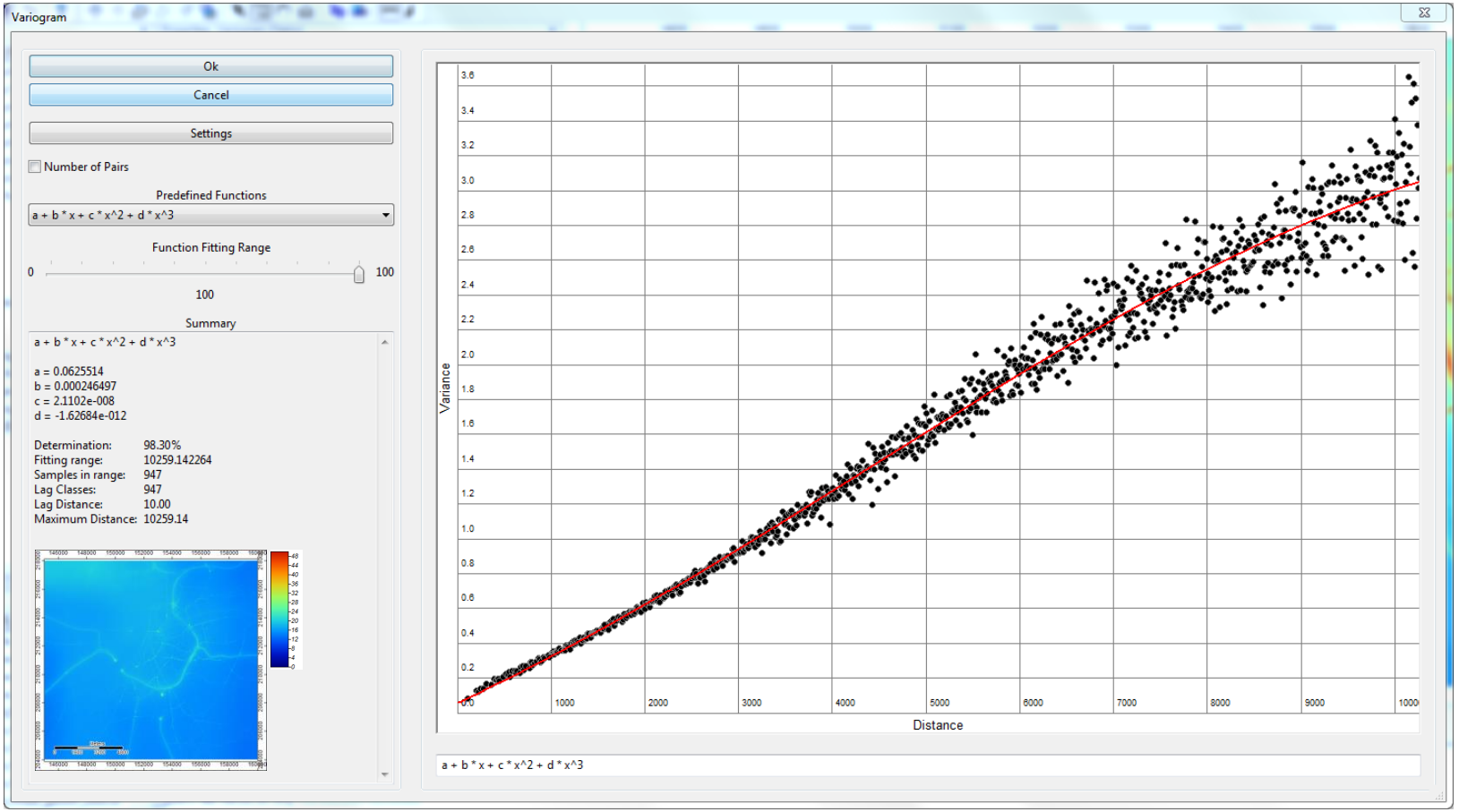


https://en.wikipedia.org/wiki/Variogram



QUESTION 4

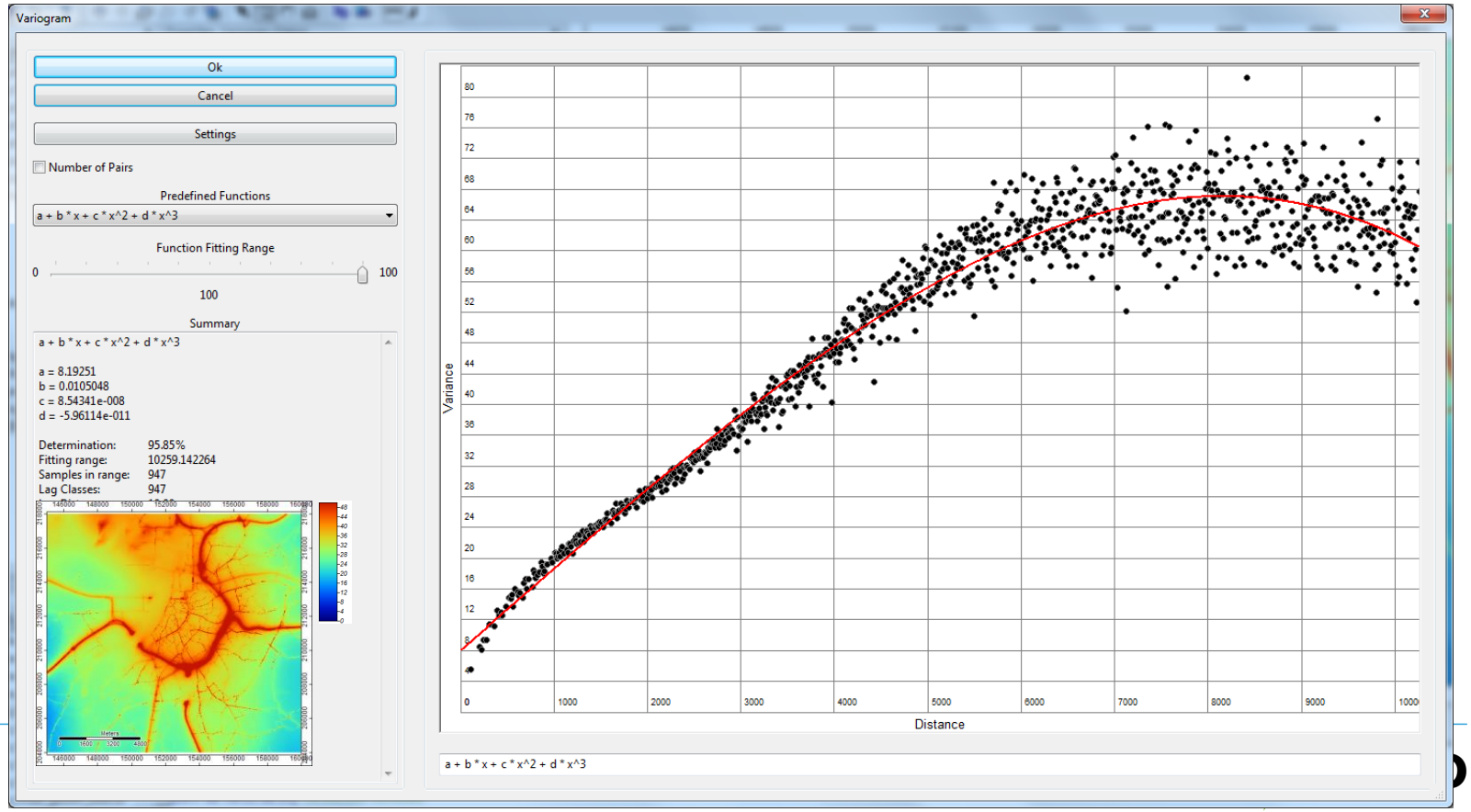
Need for spatial metric



QUESTION 4

Need for spatial metric

- Semi-variogram as measure for the spatial structure ?
  - Need high density datasets
  - Can model reproduce the experimental semi-variogram ? → Curieuzeneuzen…



QUESTION 4

Need for spatial metric

- NO_2 average may 2016
- Passive samplers (Palmes tubes)
- 2000 volunteers

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QUESTION 4

Need for spatial metric

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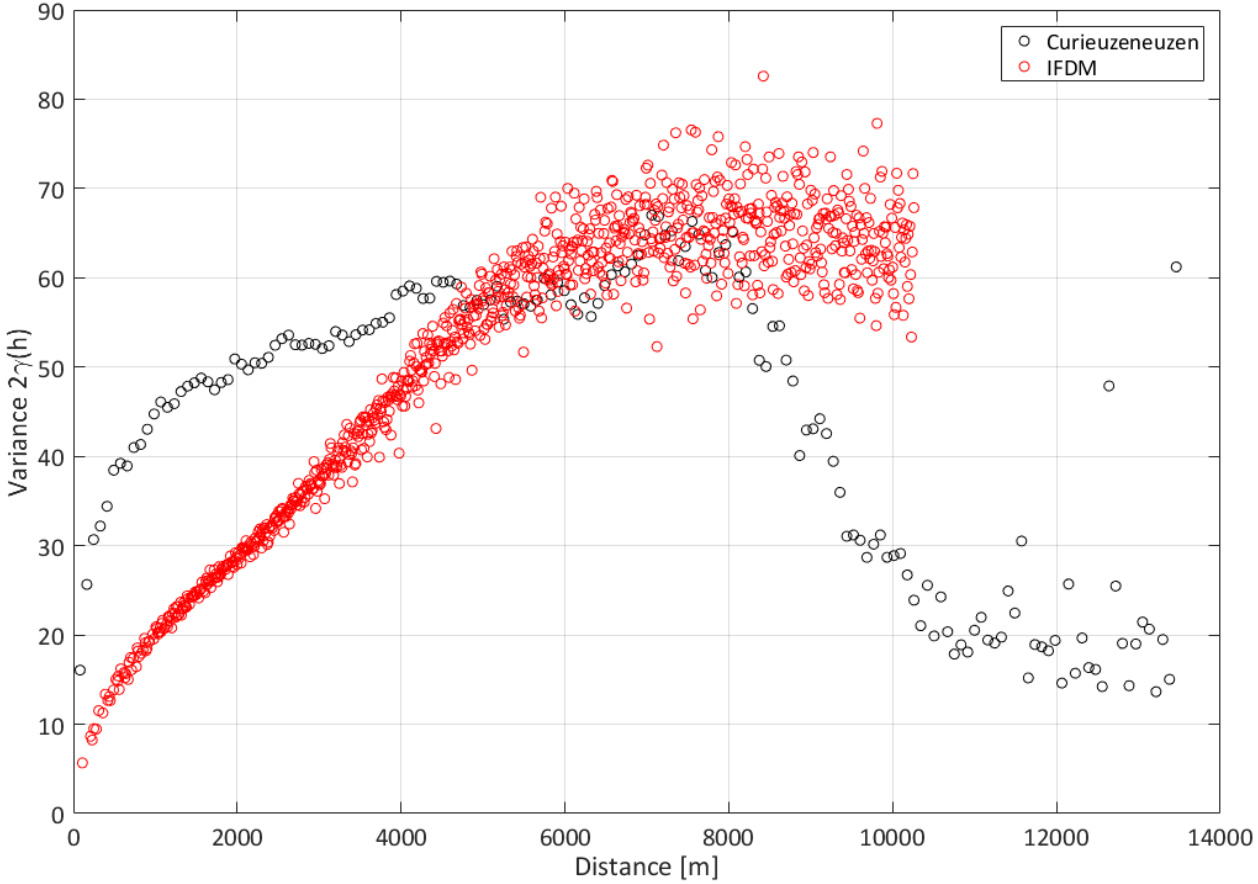

QUESTION 4

Need for spatial metric

- Is semi-variogram the best metric ?
  - Directionality…
- Some kind of 2D spatial Fourier or wavelet analysis ? Compare spectra of spatial “frequencies” ?
- …

QUESTION 4

QUESTION 4

Can you come up with proposal for the required spatial resolution for annual averaged NO_2 and $PM_{2.5}$ simulations? What kind of information do you base your proposal on?

- This again depends on the purpose (Question 1)
  - Exceedance modelling : street canyon level
  - Exposure modelling for health impacts
    - Static & current CRF : urban background with road contribution prob. enough : compatibility with CRF
    - Dynamic exposure : street canyon level

- $PM_{2.5}$ much more regionally driven