VALIDATION RIO-IFDM-OSPM USING "CURIEUZENEUZEN" : LIMITATIONS

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OUTLINE

- The curieuzeneuzen project → VUB VRIJE UNIVERSITEIT BRUSSEL Universiteit Antwerpen
- Validation of the IFDM-OSPM-model chain
- Difficulties & lessons learned

CURIEUZENEUZEN

VUB VRIJE UNIVERSITEIT BRUSSEL

Universiteit Antwerpen

KU LEUVEN RESEARCH INSTITUTE FOR WORK AND SOCIETY

HIVA

wetenschapswinkel.be

STAD ANTWERPEN

CURIEUZENEUZEN

Aims

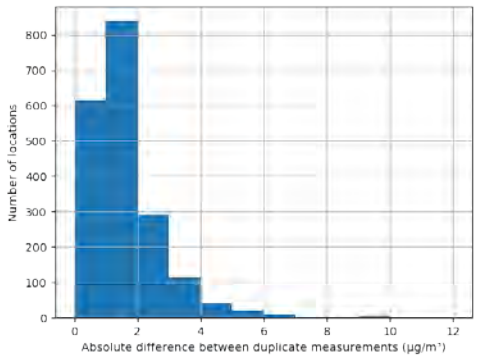
- Scientific aims
  - Quantitatively map the variation of NO_2 at neighbourhood scale in Antwerp
  - Ground truth of computer models for NO_2 assessment
- Societal aims
  - Awareness raising
  - Demonstrate potential of citizen science
  - Ringland
- Campaign
  - May 2016 (4 weeks)
  - Palmes tubes passive samplers
- Information collected :
  - Time of measurement
  - Location (x,y,z)
  - Position w.r.t. building (front, back, floor)
  - Special remarks

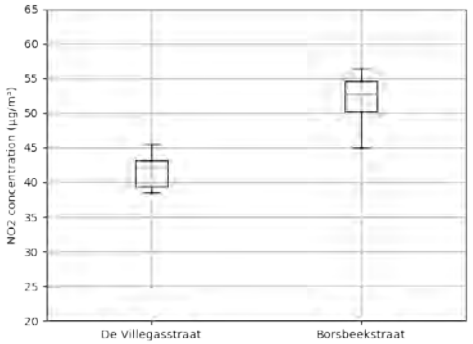

RINGLAND
ACADEMIE
CURIEUZE NEUZEN
NO2
De luchtkwaliteit op 2000 meetlocaties
WWW.CURIEUZENEUZEN.ORG
#CURIEUZENEUZEN
Met de steun van
Universiteit Antwerpen
Vrije Universiteit Brussel
WETENSCHAPSwinkel
KU LEUVEN
HIVA
STAD ANTWERPEN
Ekeren
Merksem
Linkeroever
Zwijndrecht
Antwerpen
Borgerhout
Wommelgem
Deurne
Burcht
Berchem
Ringlandfestival
Hoboken
Kruibeke
Wilrijk
Edegem
Hove
NO2-concentratie µg/m³
+65
60-65
55-60
50-55
45-50
40-45
35-40
30-35
25-30
-25

CURIEUZENEUZEN

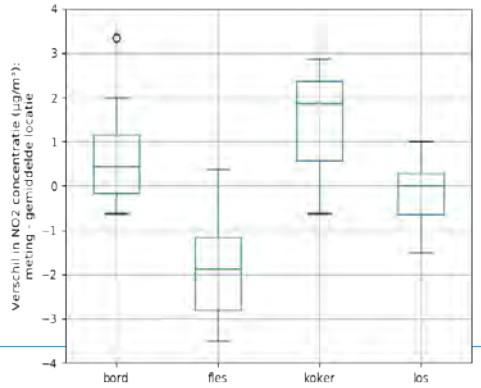
Quality control

- Reproducability : ~1.14 µg/m3, 4.4 % difference between 2 tubes



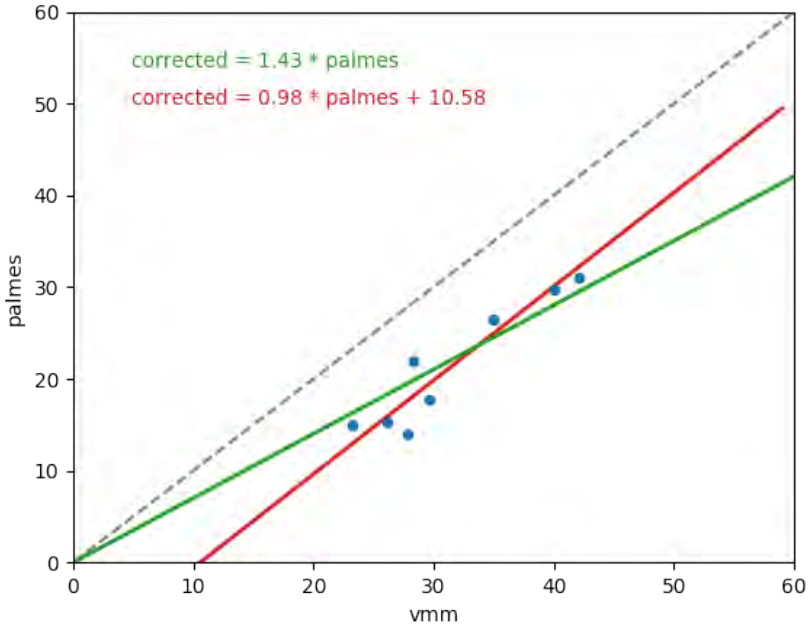


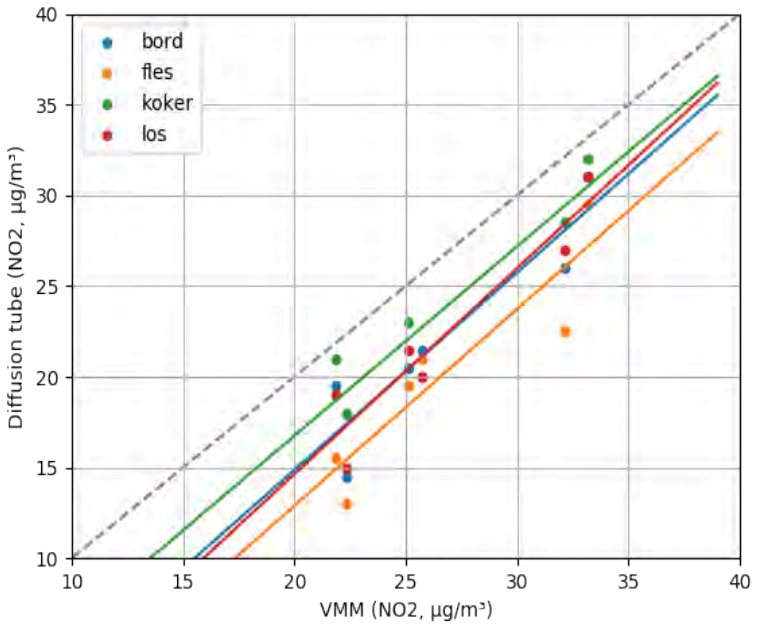
- Quality control vs. official stations
  - Calibration period (may & august)



CURIEUZENEUZEN

Calibration





- » NO_2 systematically lower than official monitoring stations
- » Linear response, with bias (10 µg/m³)
- » Different calibrations for different method of suspension : explains part of the bias

ATMOSYS MODEL CHAIN

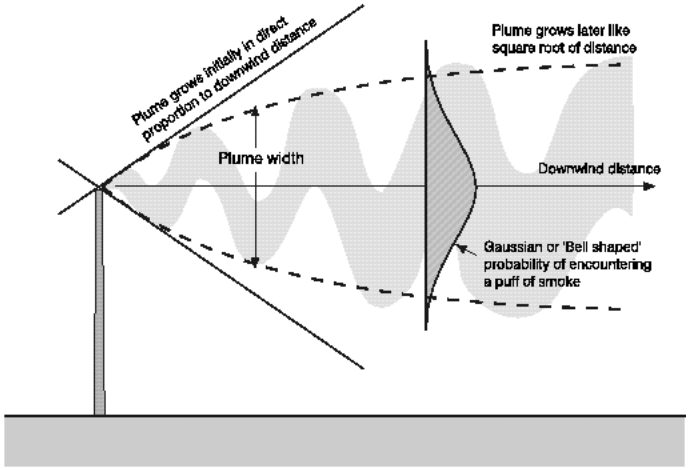
GIS preprocessing module

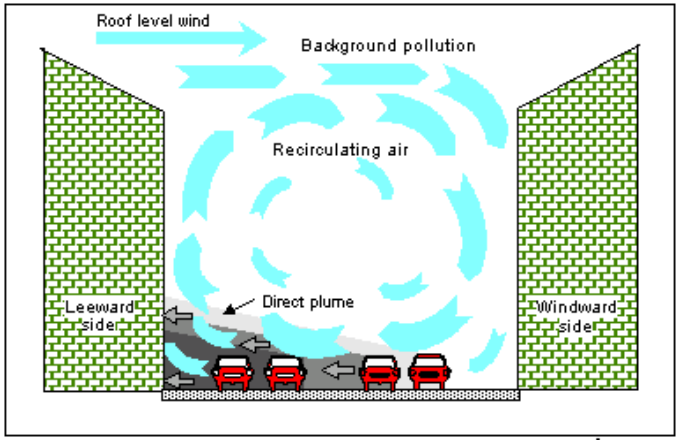
www.atmosys.eu

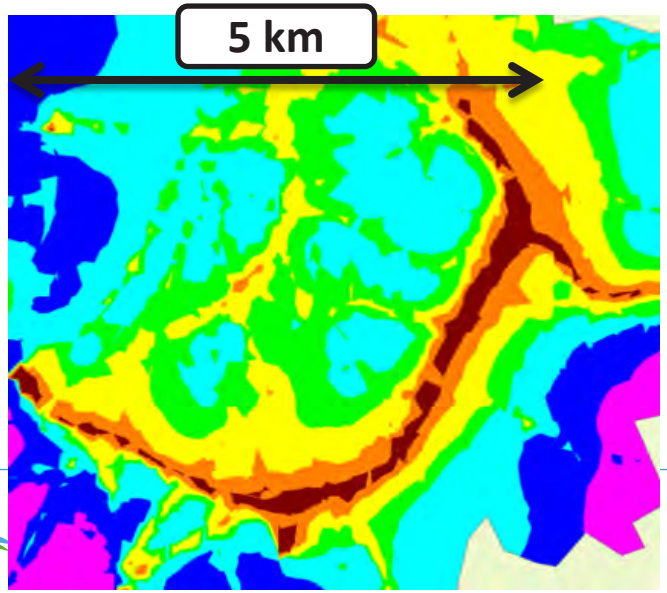
IFDM
Urban scale traffic

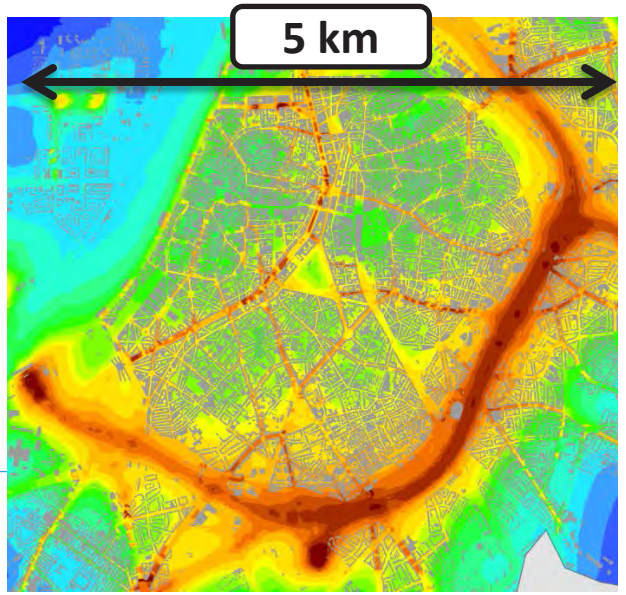
Coupling procedure

OSPM
Street-canyon module



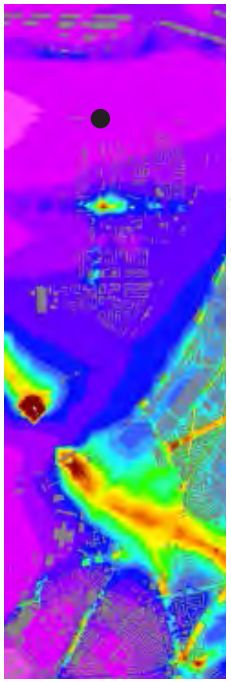


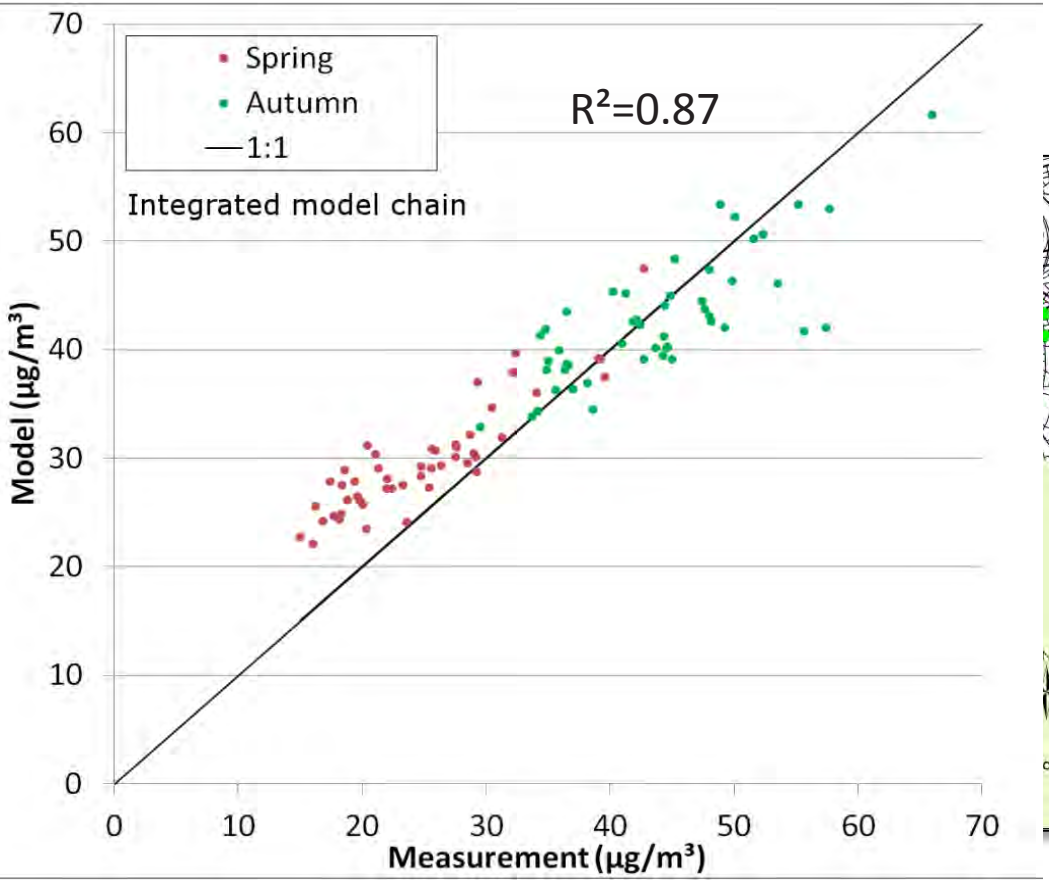




AIR QUALITY MODELLING FOR ANTWERP

NO_2 exposure camp

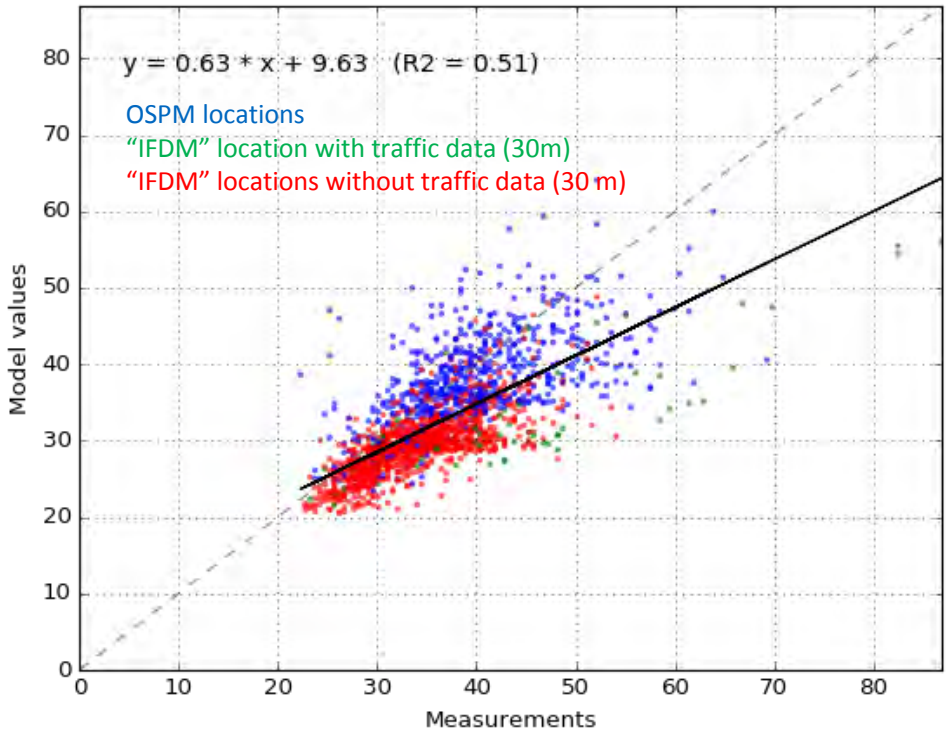




- HEAPS (Health Effects of Air Pollution in Antwerp Schools)
- Lefebvre, W., Van Poppel, M., Maiheu, B., Janssen, S., Dons, E., 2013. Evaluation of the RIO-IFDM-street canyon model chain. Atmos. Environ. 77, 325–337. doi:10.1016/j.atmosenv.2013.05.026

VALIDATION GENERAL OVERVIEW

- Short comings in traffic input data :
  - Missing roads
  - Traffic counts & fleet composition (nr. busses / cars / …)
- Are urban driving conditions reflected in emissions (stop/go, red lights, …)
- Model assumptions
  - Street canyon preprocessing : H,W,distance to crossing, ….
  - Complexity of street canyons
- Measurement uncertainty
  - Height of samplers : incomplete/rough information
  - Validity of calibration

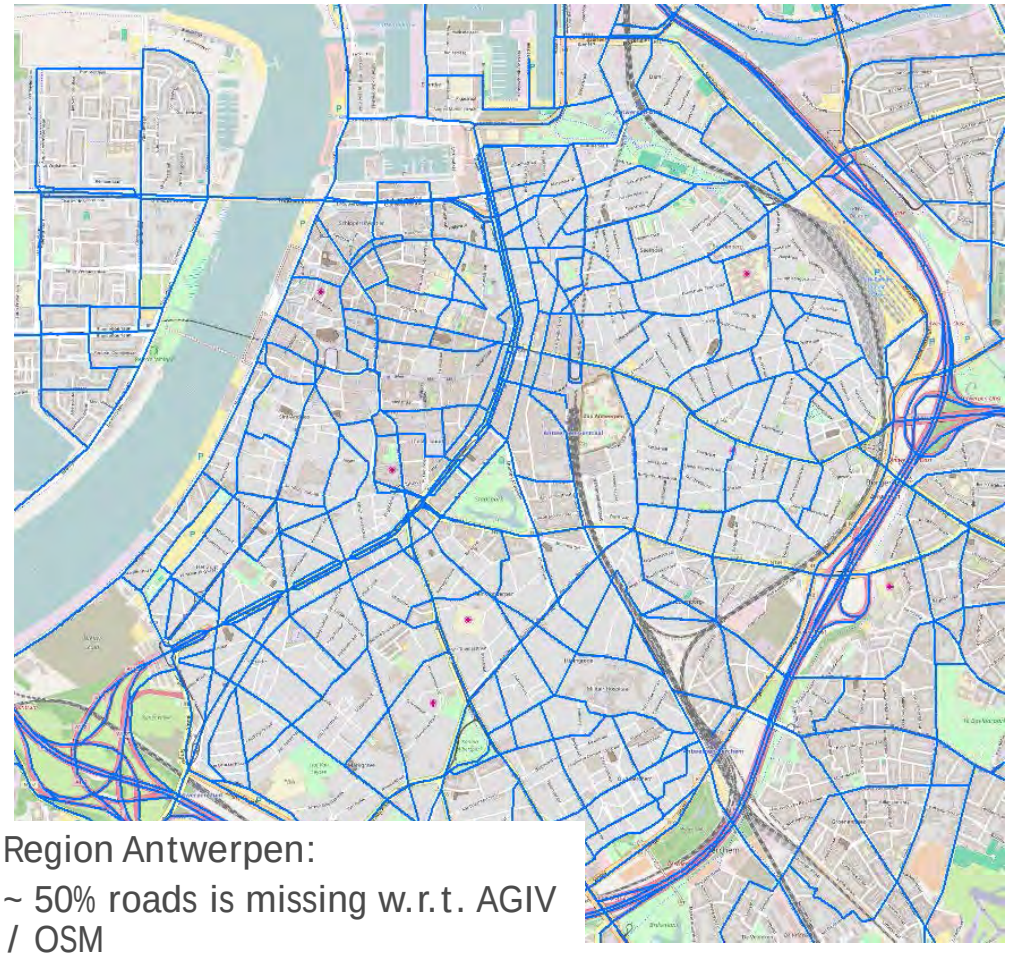


- Underestimation of highest values
- Better results at "OSPM" locations

MISSING ROADS

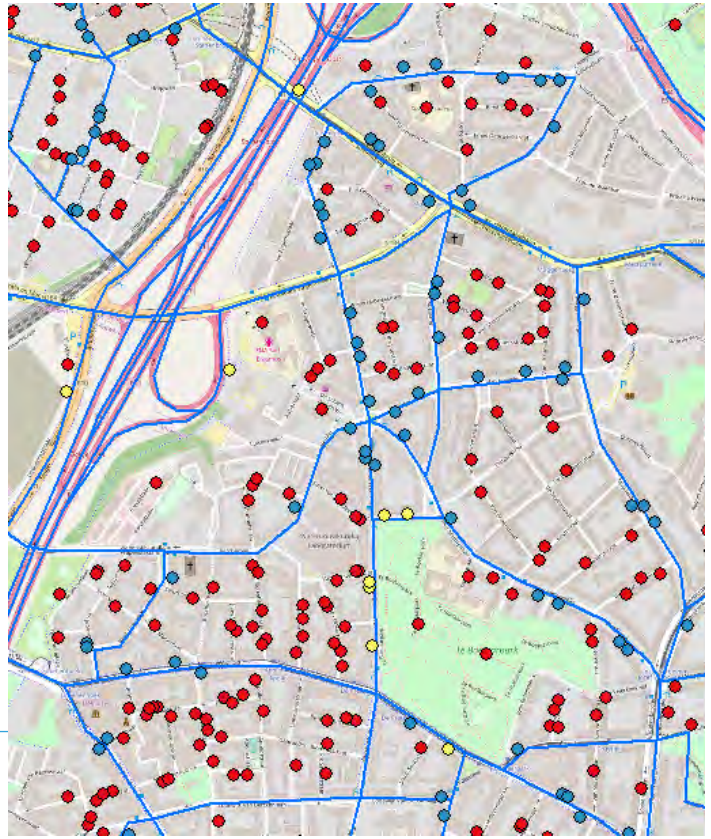
Traffic data is incomplete

	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:

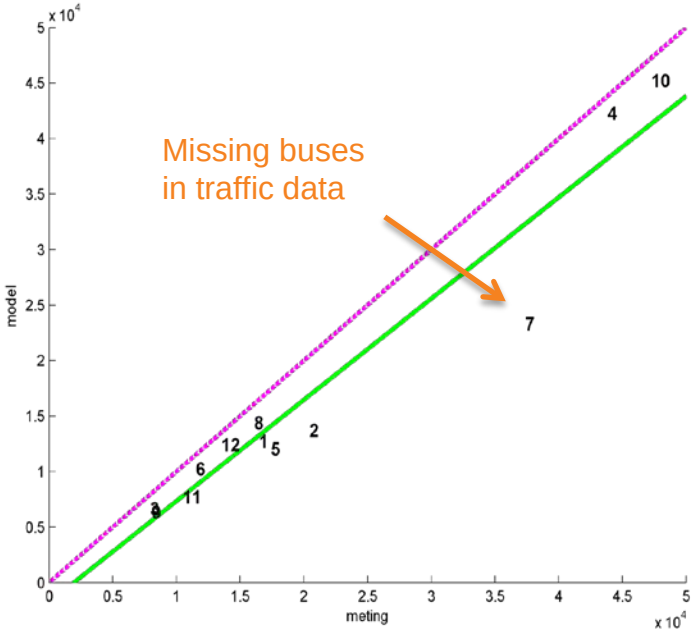
~ 50% roads is missing w.r.t. AGIV / OSM



vito

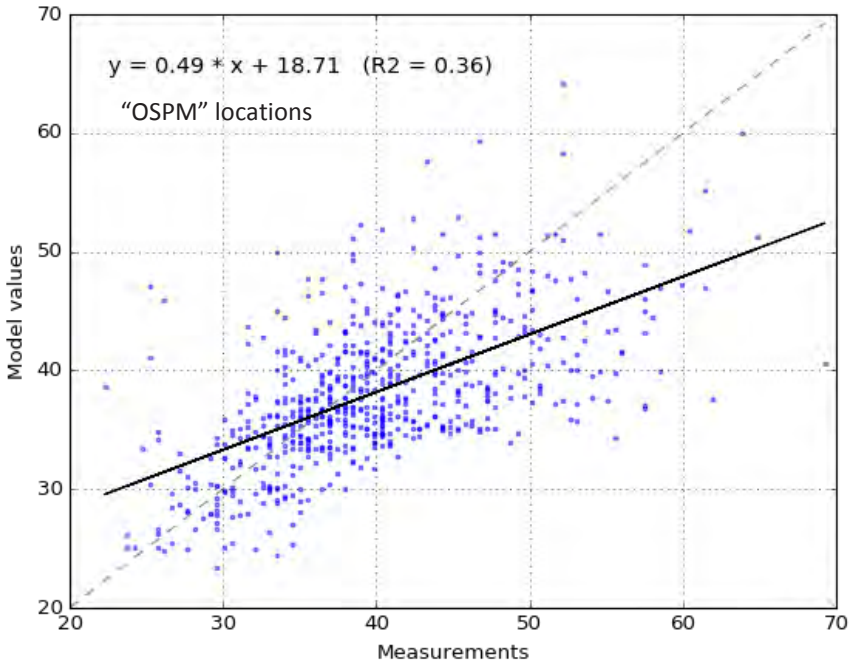
TRAFFIC COUNTS / FLEET COMP.

- Are traffic counts correct ?
  - Indications for deviations from previous work
    - Missing busses (Turnhoutsebaan)
- Some comparisions were performed with local traffic counts (Joris, VUB)
  - No strong indications for this problem
  - No distinction bus /cars
  - Short term measurement campaigns (4 weeks in october)
- However :



CONGESTION – START/STOP

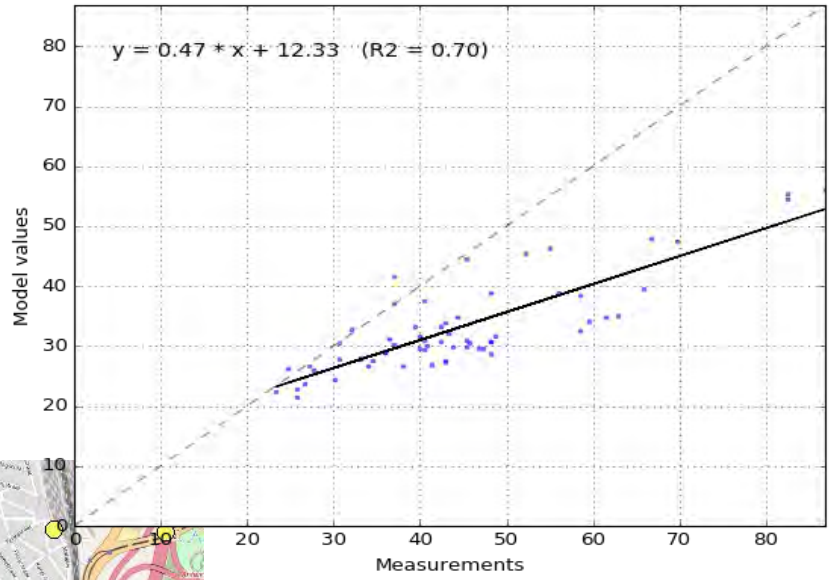
- Model insufficiently accounts for urban traffic conditions : start/stop, congestion
  - Free flow traffic intensities were used (VVC, unclear how start/stop is taken into account)
- Previous validation of model chain at Flanders scale (IRCELINE) :
  - Strongest underestimations near traffic light locations

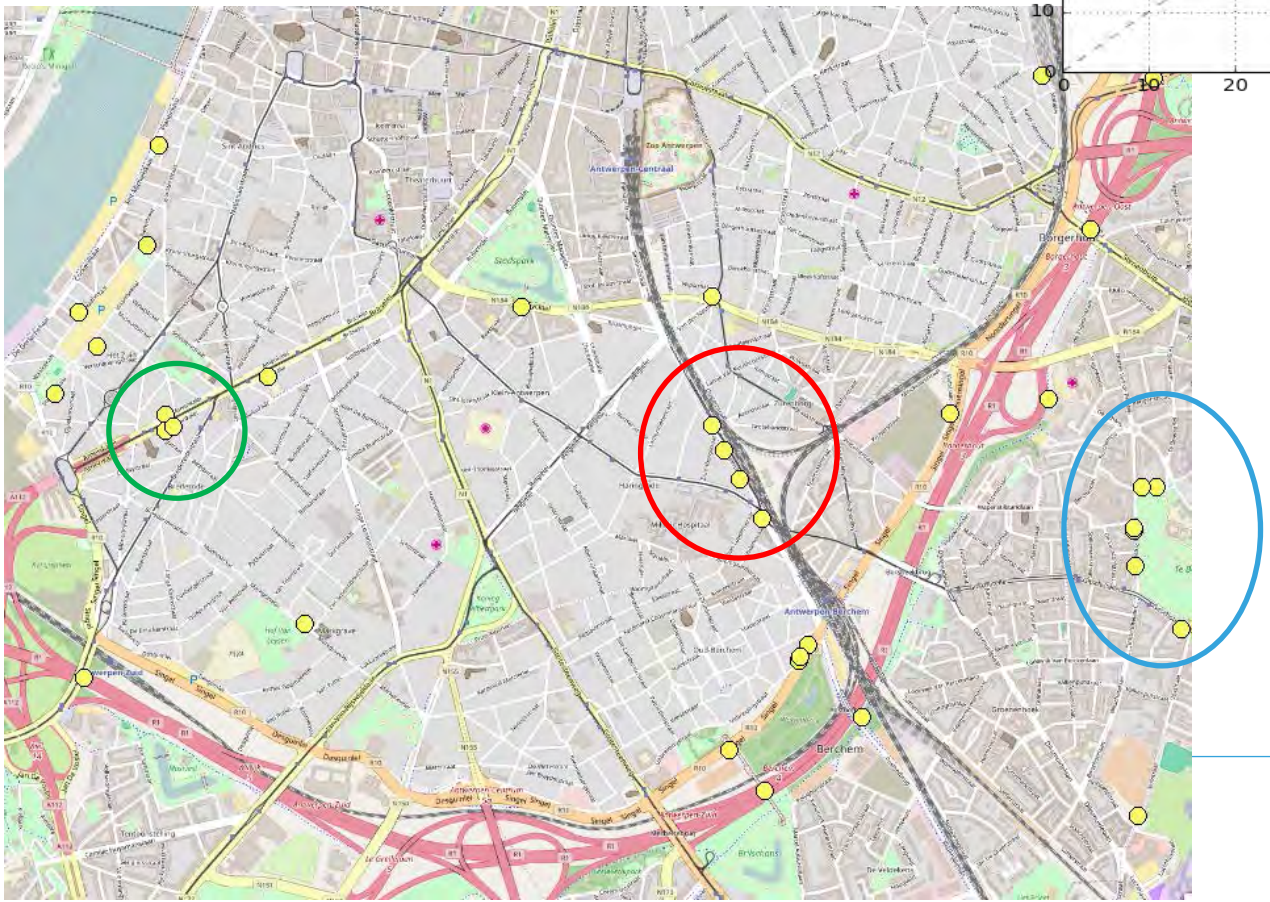


WHAT IS A STREET CANYON ?

Non-OSPM locations

- » Half-open canyons are not taken into account
- » Complex situations
- » Deviations in 3D data





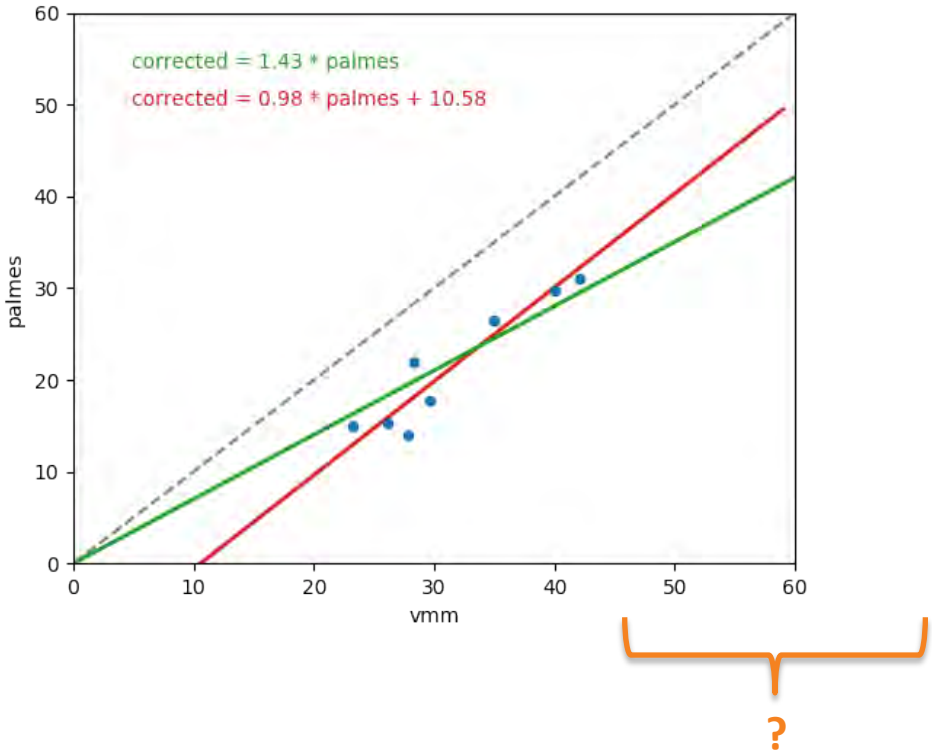
	Alle punten	niet-OSPM locaties
Aantal	1891	63
Bias	-11%	-26%

COMPLEX STREET CANYONS

OSPM is not made for more complex street-canyon configurations

OTHER MEASUREMENT UNCERTAINTIES

- **Calibration of samplers : how universal is it ?**



- **Uncertainty w.r.t. measurement height**
  - Using rope
  - Or derived from floor number

LESSONS LEARNED

- Citizen science projects can be a fantastic source for air quality monitoring data, however
  - Elaborate calibration needed w.r.t. reference measurements !
  - Enough & adequate meta data is crucial !

- Performing an elaborate validation at street-canyon scale with ~2000 measurements is not a trivial task
  - More monitoring locations means more requirements on detail in input data
  - Geometric accuracy of validation points (inside canyon or not)
  - Model coupling & interpolation
  - Microscale effects (terrain features, vegetation, tunnel exits, …)

- In general : underestimation of highest concentration values

- Different reasons for deviations & difficult to disentangle sources of uncertainty
  - More work needed here..