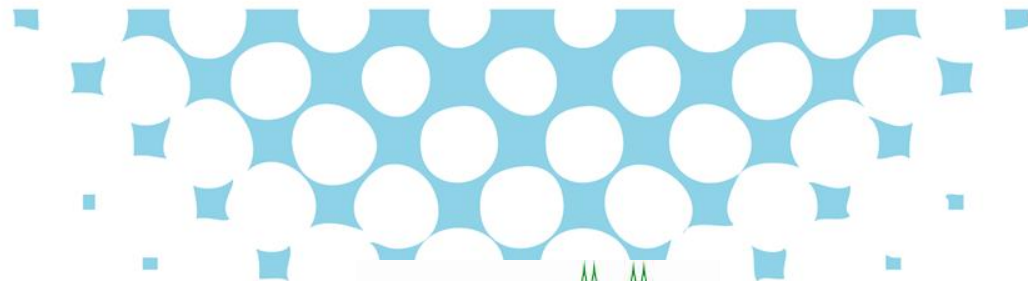


The added value of UFP monitoring in urban environments: assessments in Amsterdam (NL), Antwerp (BE), Leicester (UK) and London (UK)

Jelle Hofman, Jeroen Staelens, Christophe Stroobants, Sarkawt Hama, Kevin Wyche, Gerard Kos, Christina Matheeussen, Rebecca Cordell, Jorrit van der Laan, Kirsty Smallbone, Arnoud Frumau, Ernie Weijers, Paul Monks, Edward Roekens



Joint Air Quality Initiative (Joaquin)



JOAQUIN

www.joaquin.eu

JOINT AIR QUALITY INITIATIVE:
AN INTERREG IWB NWE PROJECT



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Joaquin (Joint Air Quality Initiative) is a new EU cooperation project supported by the INTERREG IWB North West Europe programme (www.nweurope.eu). The aim of the project is to support health-oriented air quality policies in Europe. To achieve this, the project will provide policy makers with the necessary evidence on the current local and/or regional situation (e.g. measurements of emerging health relevant parameters), provide them with best-practice measures that can be taken and motivate them to adapt and strengthen their current air quality policies

As part of the "Cleaner Air, Better Health" campaign, we also created a [website](#) for the general public with comprehensible information on air quality.

NEWS

[Save the date: Cleaner Air Better Health, Amsterdam 11 June 2015](#)

organising the "Cleaner Air Better Health" event in Amsterdam (full day)

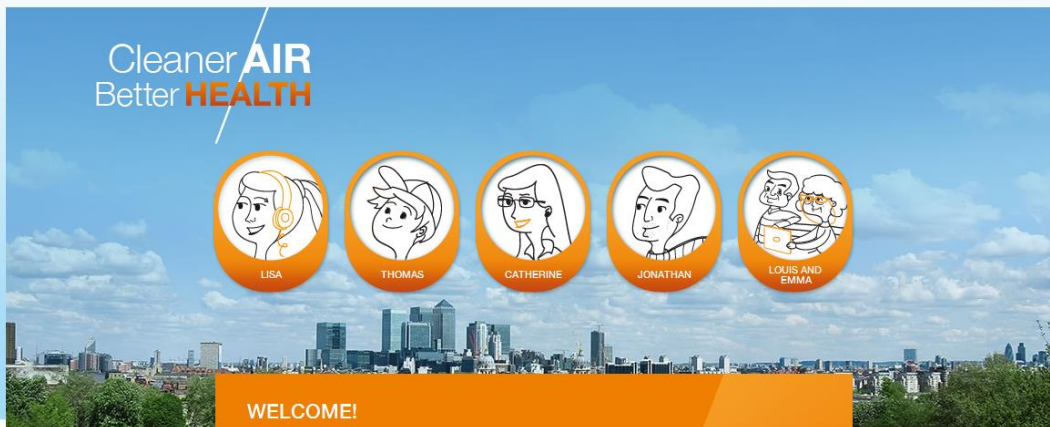
< September 2015 >

Mo	Tu	We	Th	Fr	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Tweets

Joaquin 25 Aug

HOME / WHAT IS AIR POLLUTION? / LINK WITH HEALTH / WHAT CAN I DO / ABOUT JOAQUIN / WHAT IS BEING DONE SO FAR? NL - FR



- provide policy with evidence on emergent pollutants → **Measurements**
- provide policy with best-practices how to deal with air pollution → **Measures**
- Create a support base of stakeholders and general public → **Communication**

Goal WP1: Measurements

Why?

Ultrafine particles (UFP) not included in current air quality monitoring programs

Goal?

“To obtain a better understanding of the UFP variation in NW European urban environments”

How?

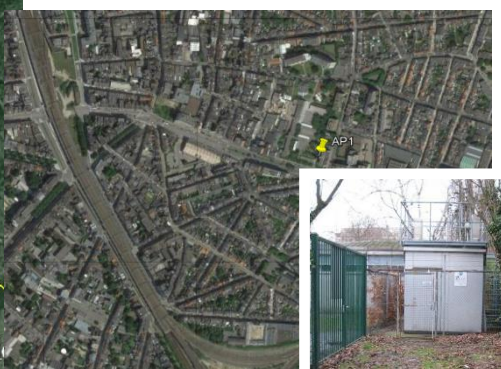
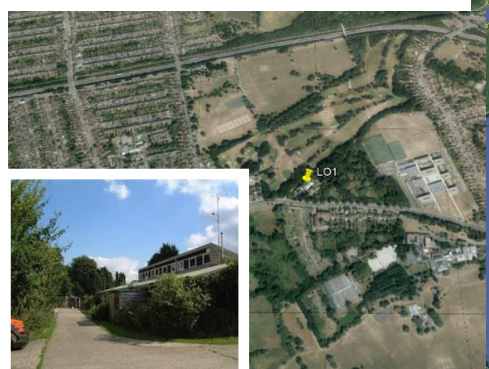
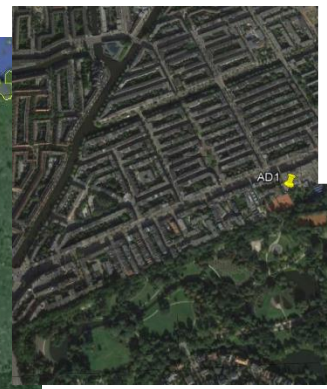
By establishing a long-term UFP monitoring network

Questions

- ✓ UFP size distribution in different cities?
- ✓ Temporal variation of UFP?
- ✓ Relation of UFP with common air pollutants (PM, NO_x, BC)?
- ✓ Influence of meteorology (e.g. wind)?
- ✓ Spatial variation of UFP: inter- vs intra-urban?

Methods – UFP monitoring network

- 4 Fixed sites
 - UFP, BC, PM & NO_x from April 2013 – March 2015
- 1 Mobile trailer
 - 4-7 weeks next to fixed site
 - Additional urban site in Amsterdam, Antwerp & Leicester



Methods - Instruments

- Total particle number concentration (TNC)
 - 7-1000 nm
 - TSI 3783: water-based CPC
- Size-resolved number concentration (PNC)
 - Grimm SMPS (45 size classes) → *Amsterdam, Antwerp*
 - TSI 3031 (5+1 size classes) → *Leicester, London*
- Black carbon (BC)
 - Multiangle absorption photometer (Thermo 5012 MAAP)
- Initial campaign for instrument comparison
 - January, 2013



Data coverage

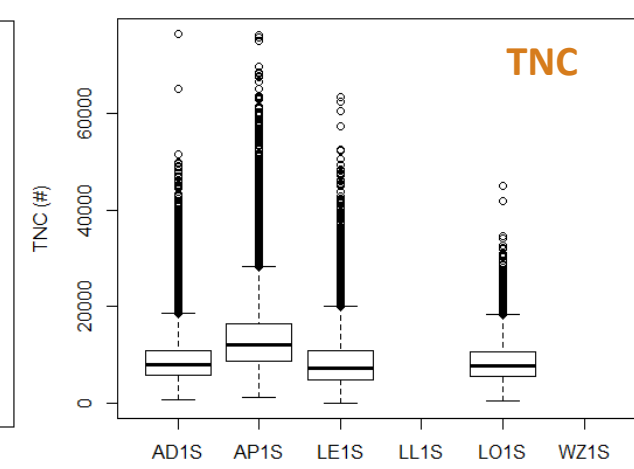
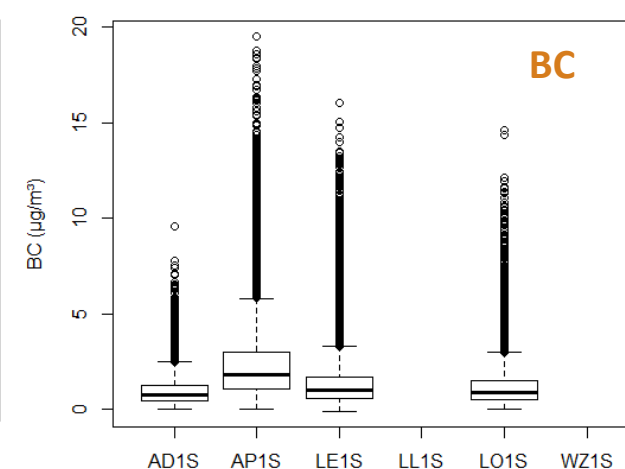
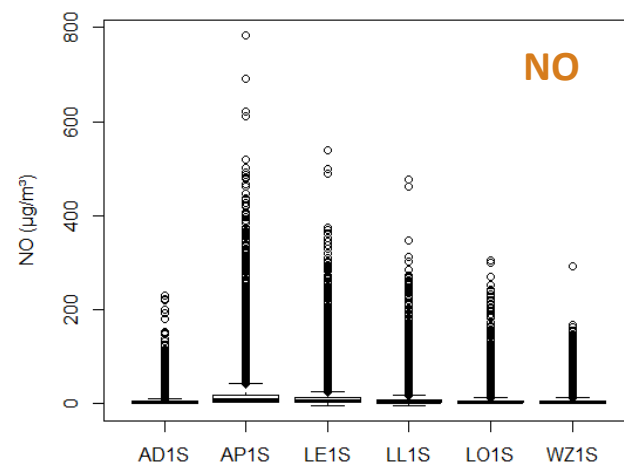
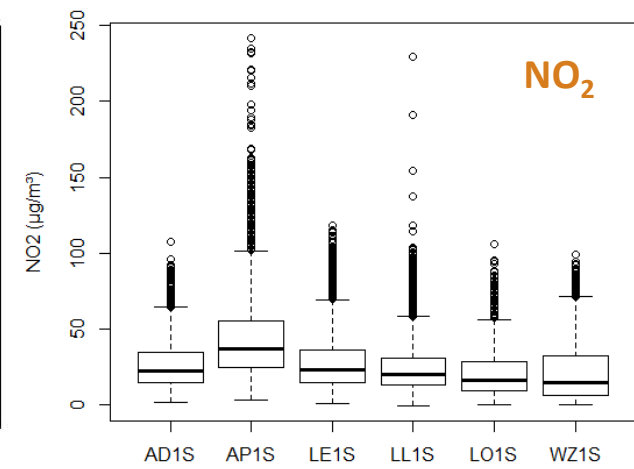
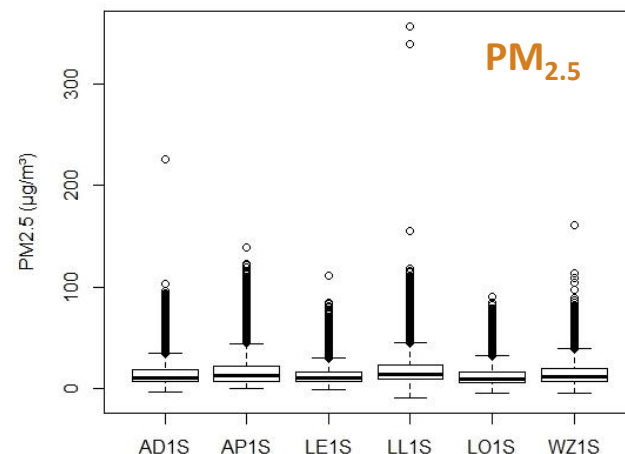
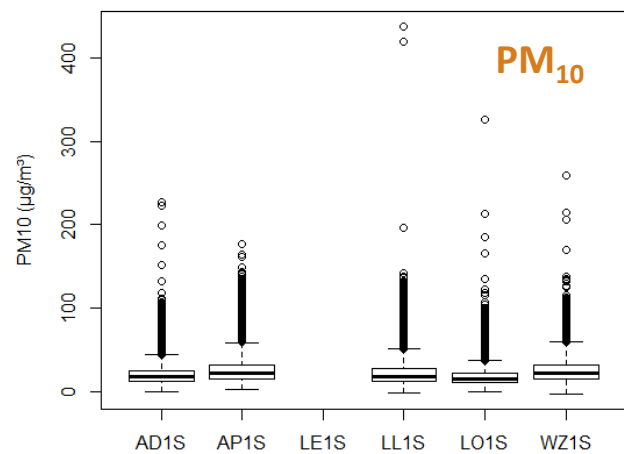
- April 2013 – March 2015
 - Total particle number concentration (TNC) > 80%
 - Size-resolved particle number concentration (PNC) > 70%

Station	Start	Stop	Observations #	PM ₁₀		PM _{2.5}		NO ₂		NO		BC		TNC		PNC		Total availability %
				NA's	%	NA's	%	NA's	%	NA's	%	NA's	%	NA's	%	NA's	%	
Amsterdam (AD1S)	01/04/2013	31/03/2015	35040	848	98	1074	97	1698	95	1698	95	240	99	6034	83	9660	72	91
Antwerp (AP1S)	01/04/2013	31/03/2015	35040	3287	91	2560	93	2478	93	2478	93	734	98	4583	87	5765	84	91
Leicester (LE1S)	01/04/2013	31/03/2015	35040	-	-	11008	69	5014	86	5008	86	4849	86	13500	61	12731	64	75
London (LO1S)	01/04/2013	31/03/2015	35040	4532	87	10466	70	6677	81	6837	80	17670	50	24719	29	24342	31	61

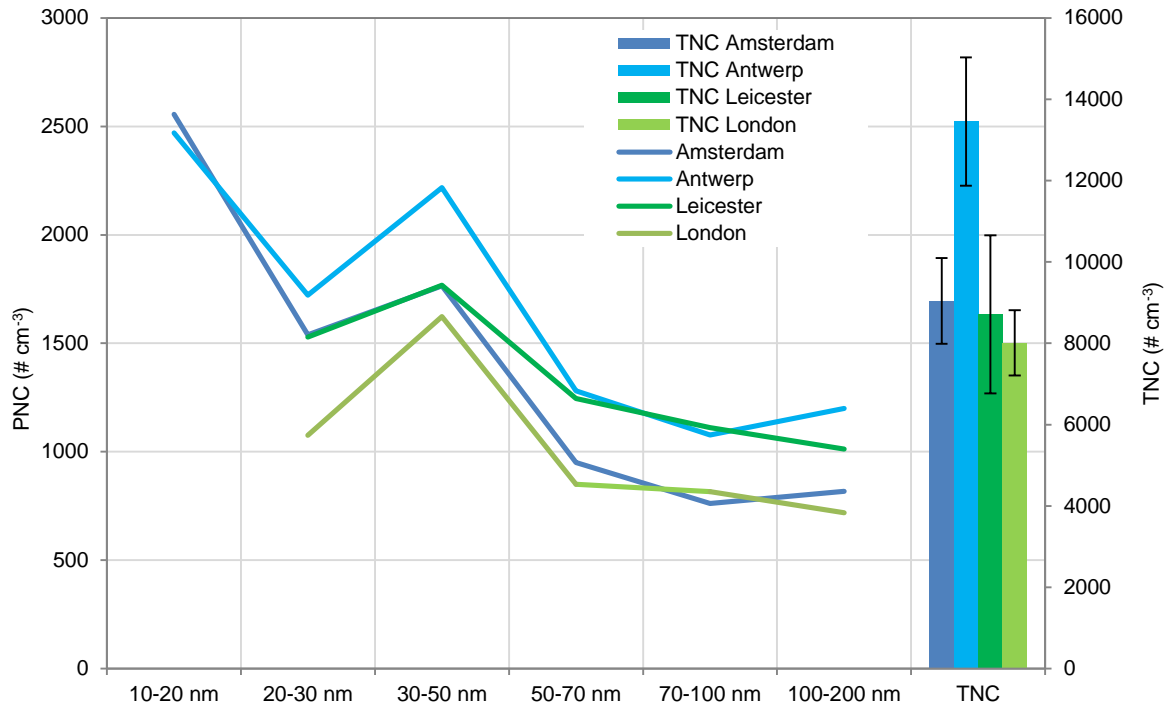
Note:

- Leicester: total and size-resolved PNC from Oct 2013 - March 2015
- London: total and size-resolved PNC and BC from Apr 2014 - Dec 2014

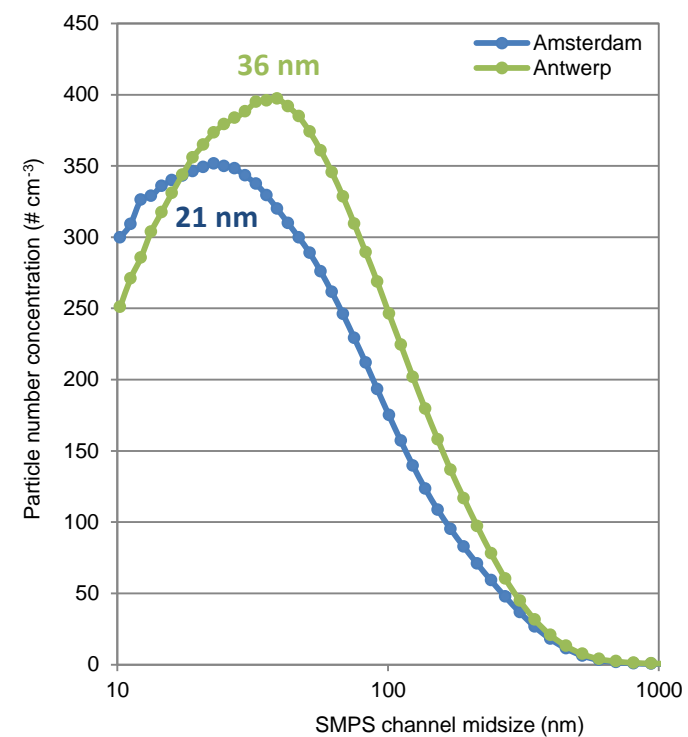
Data overview



UFP size distribution



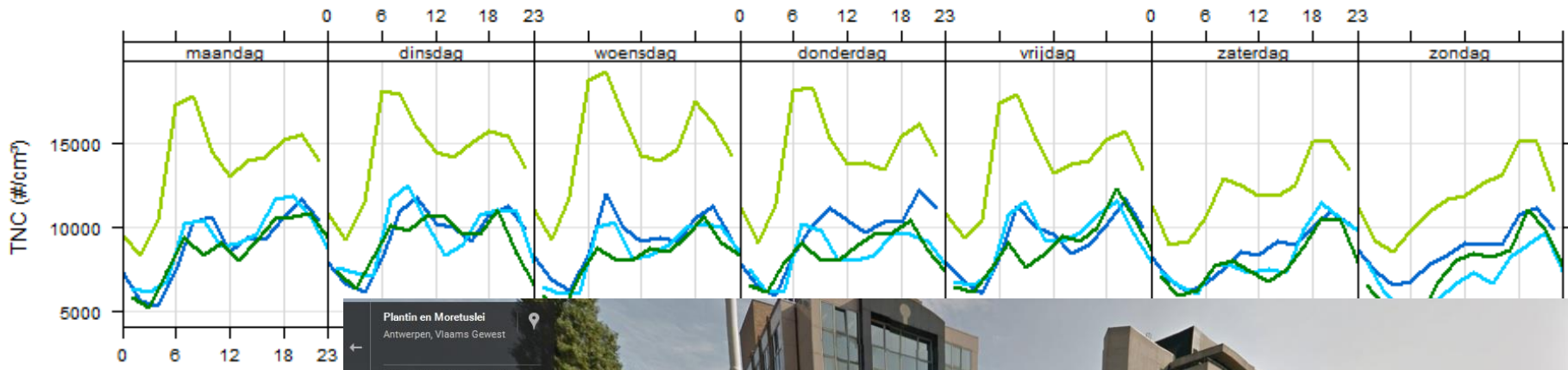
TSI 3031 channels (5)



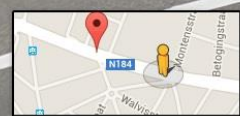
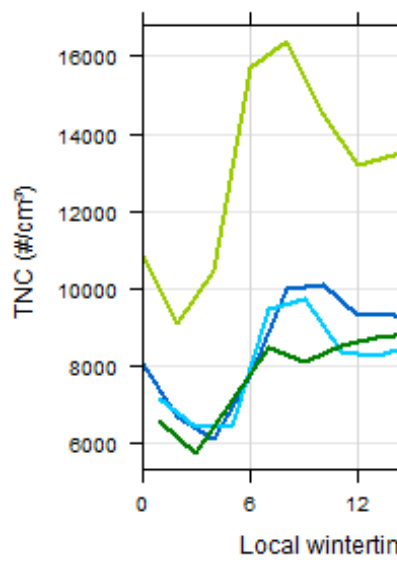
SMPS channels (45)

10-20 nm > 30-50 nm > 20-30 nm > 50-70 nm > 100-200 nm > 70-100 nm

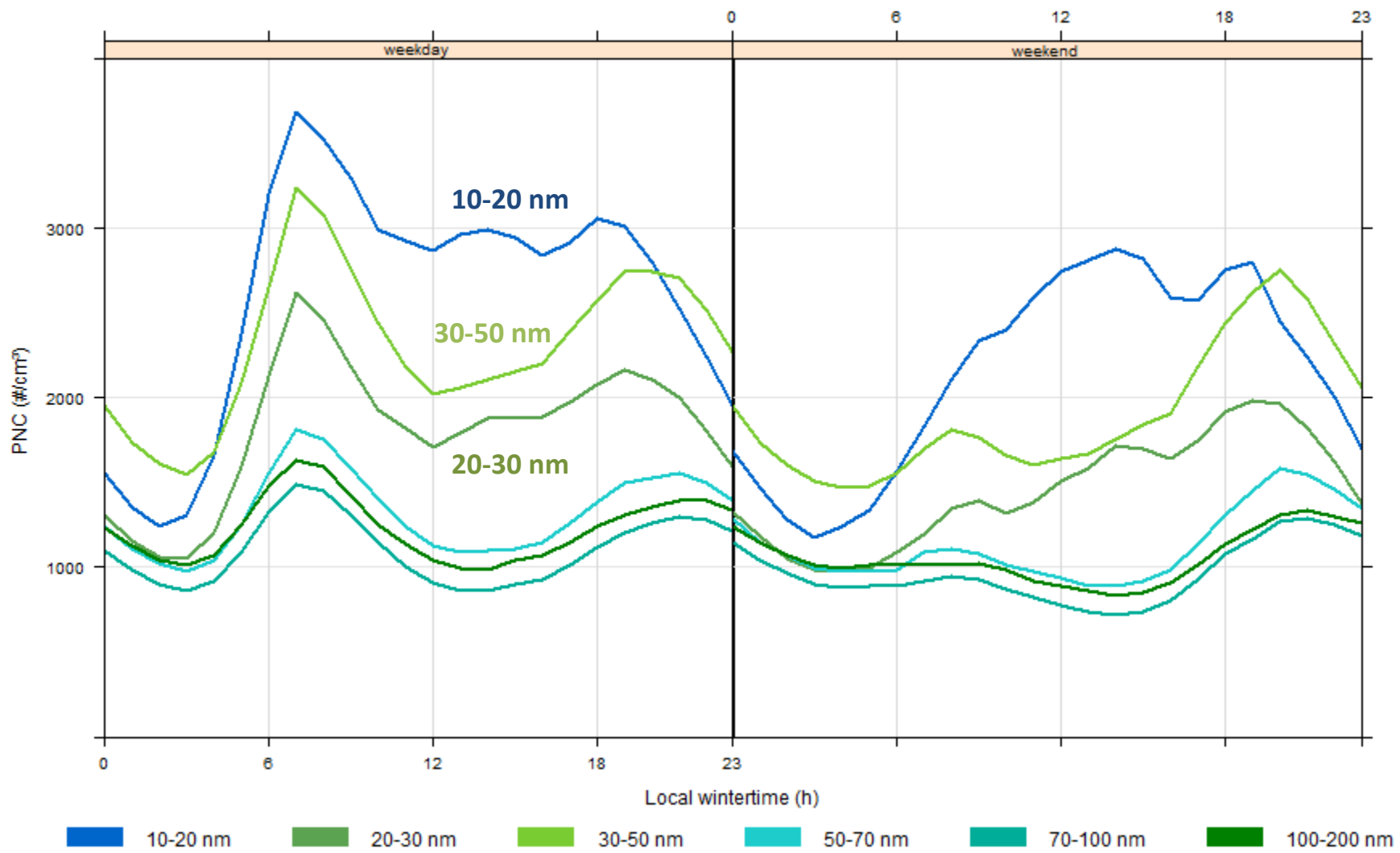
Temporal variation TNC



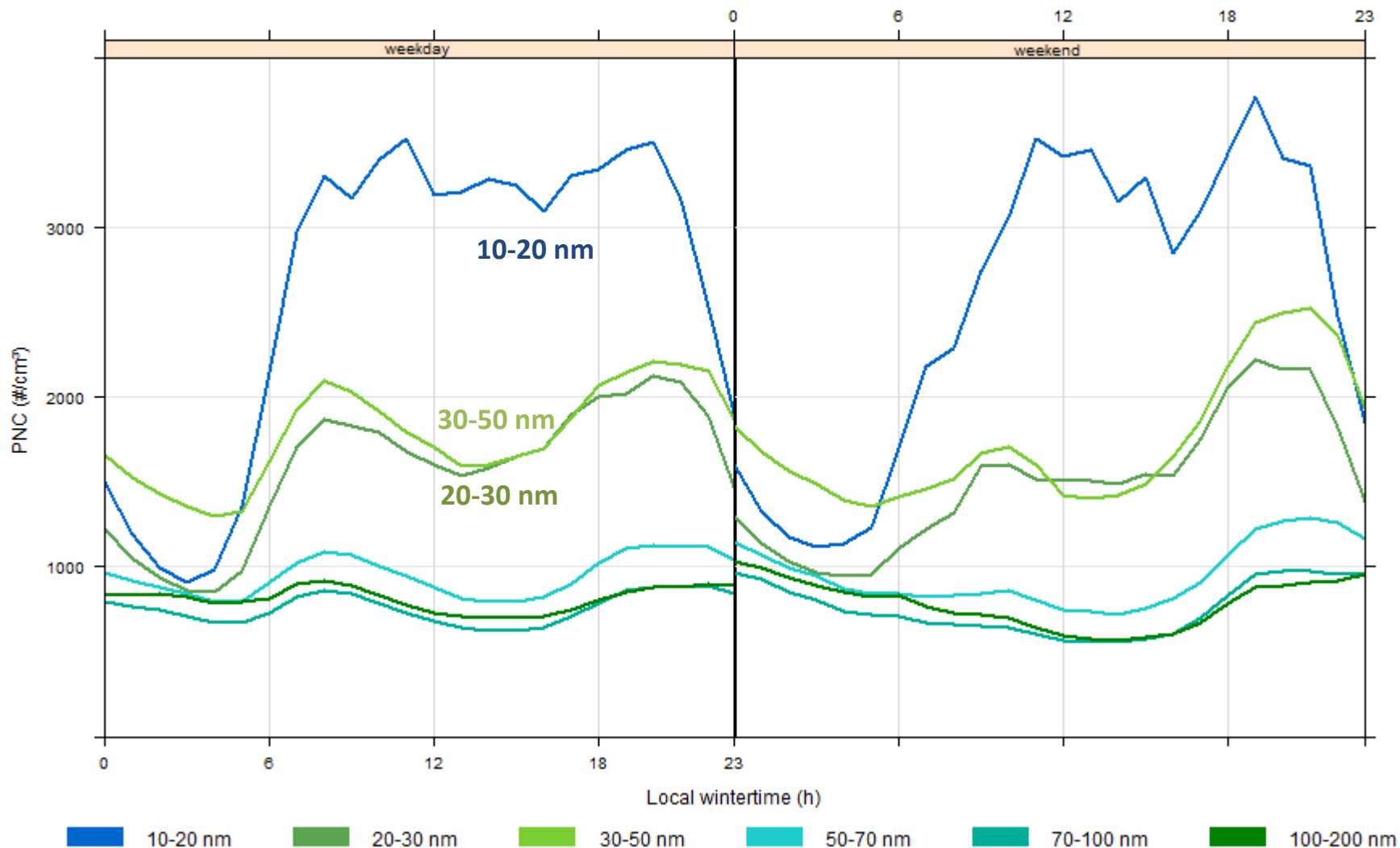
Plantin en Moretuslei
 Antwerpen, Vlaams Gewest
 Street View - aug. 2013



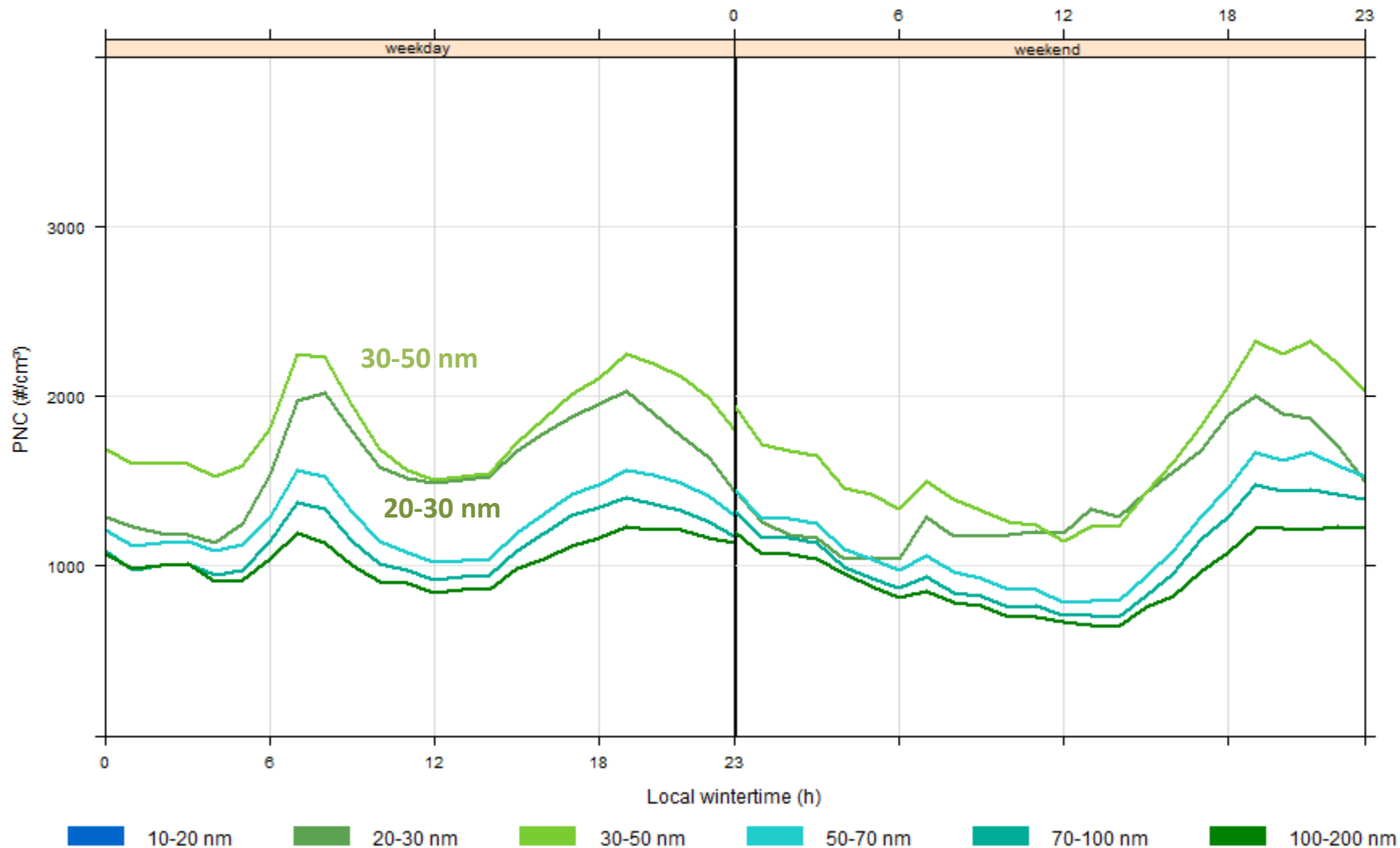
Temporal variation UFP Antwerp



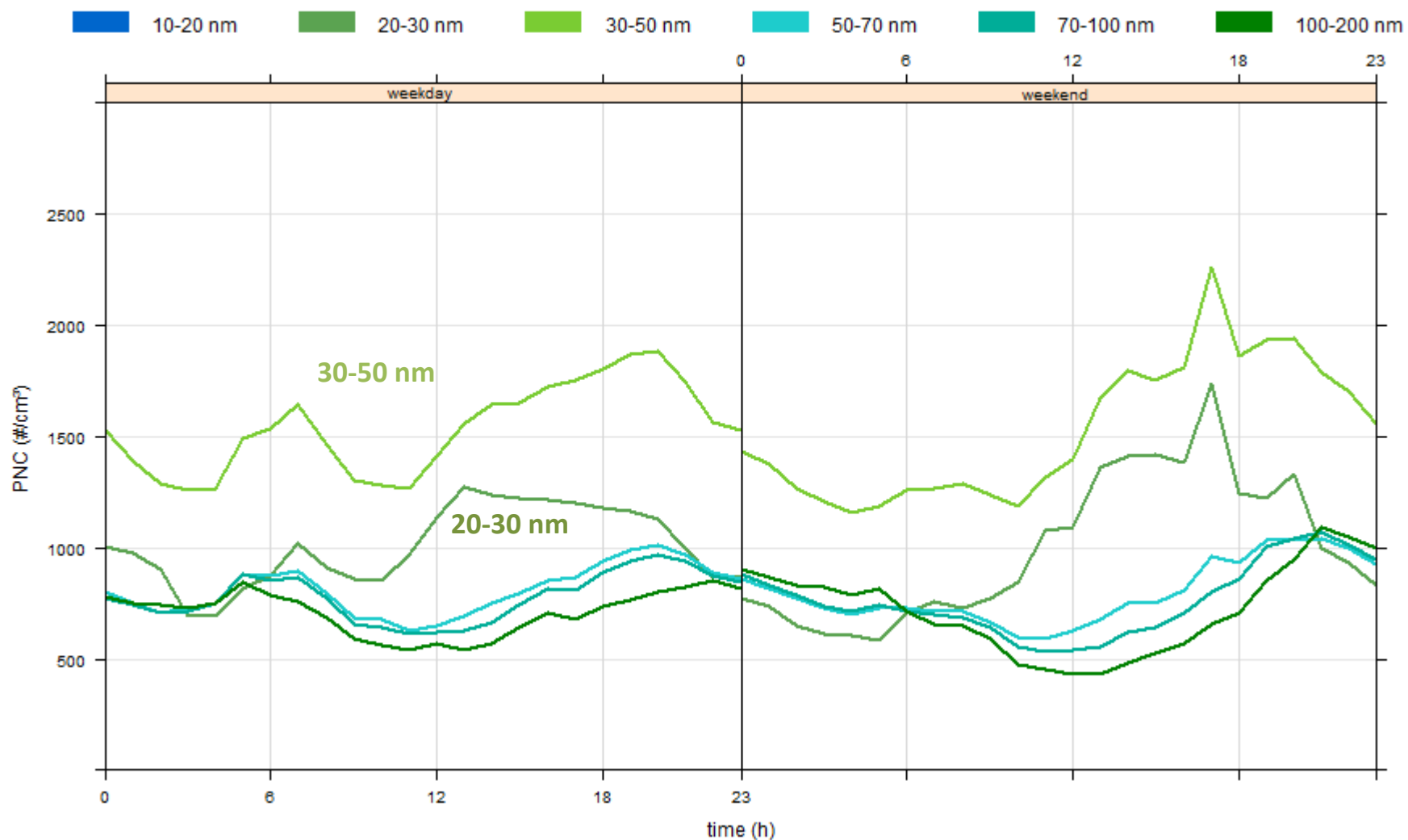
Temporal variation UFP Amsterdam



Temporal variation UFP Leicester

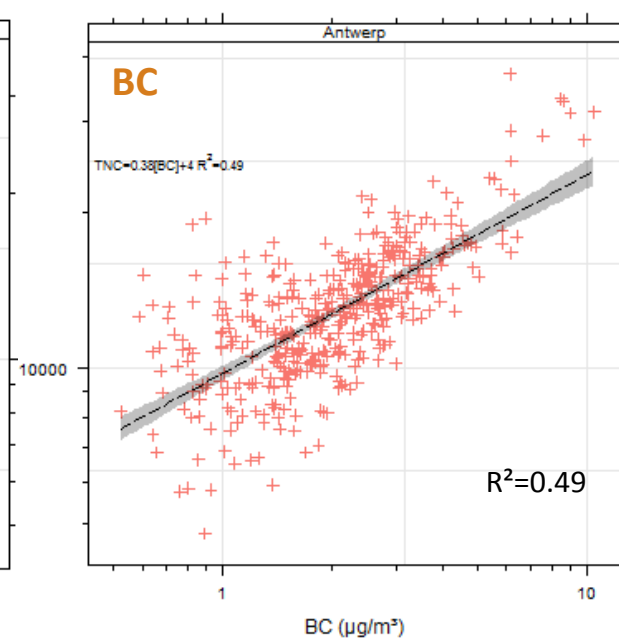
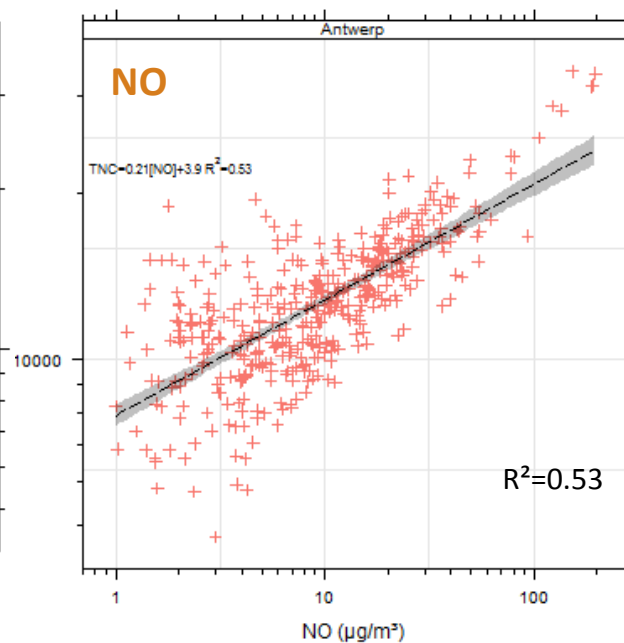
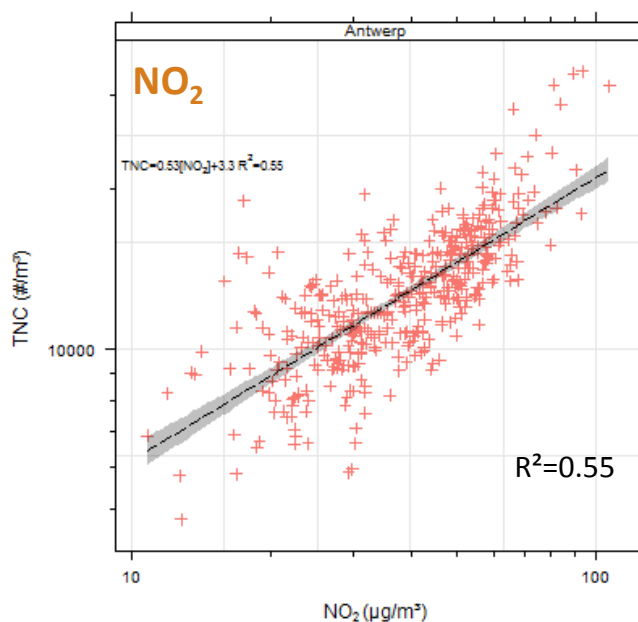


Temporal variation UFP London

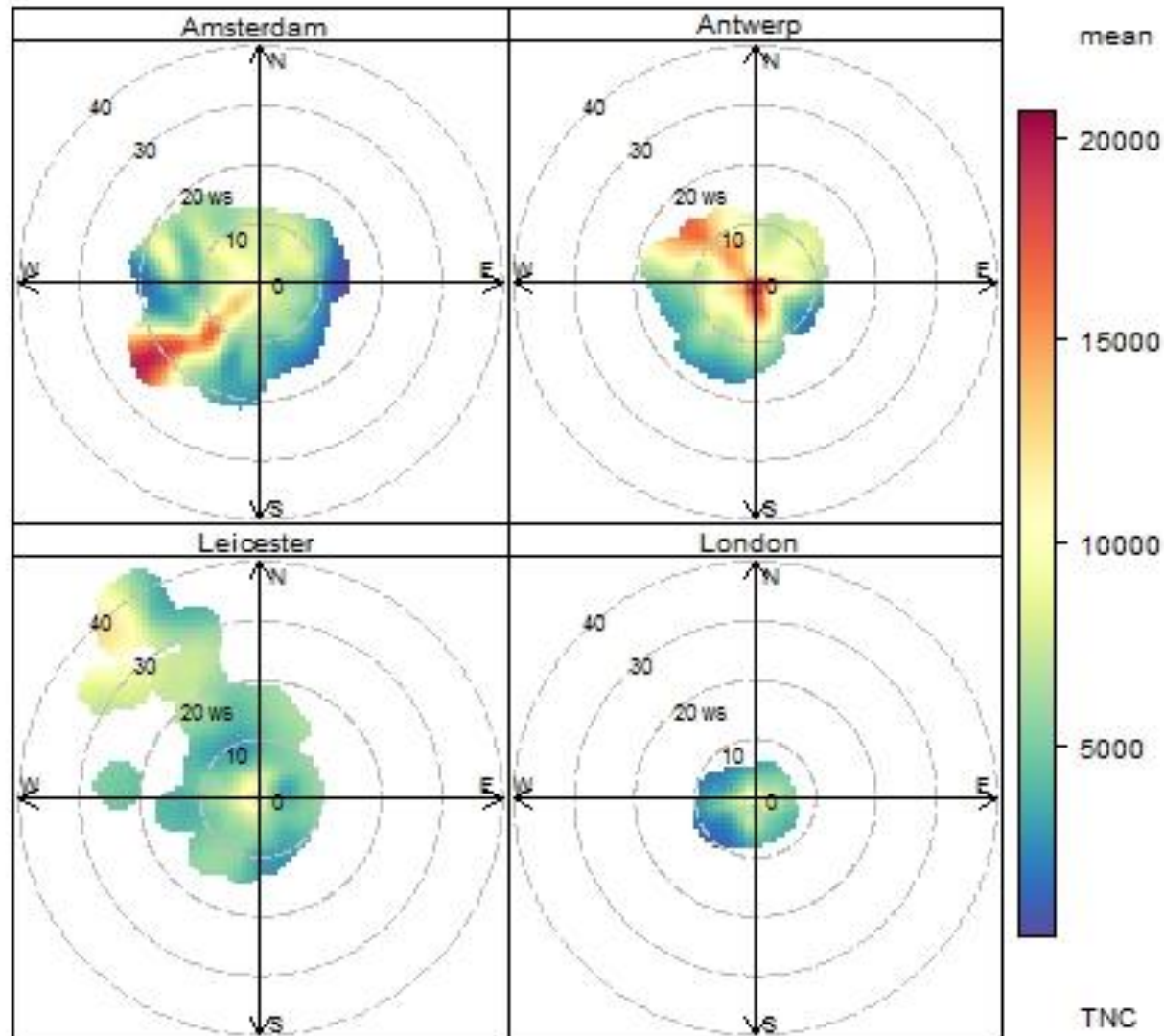


Relations with other pollutants

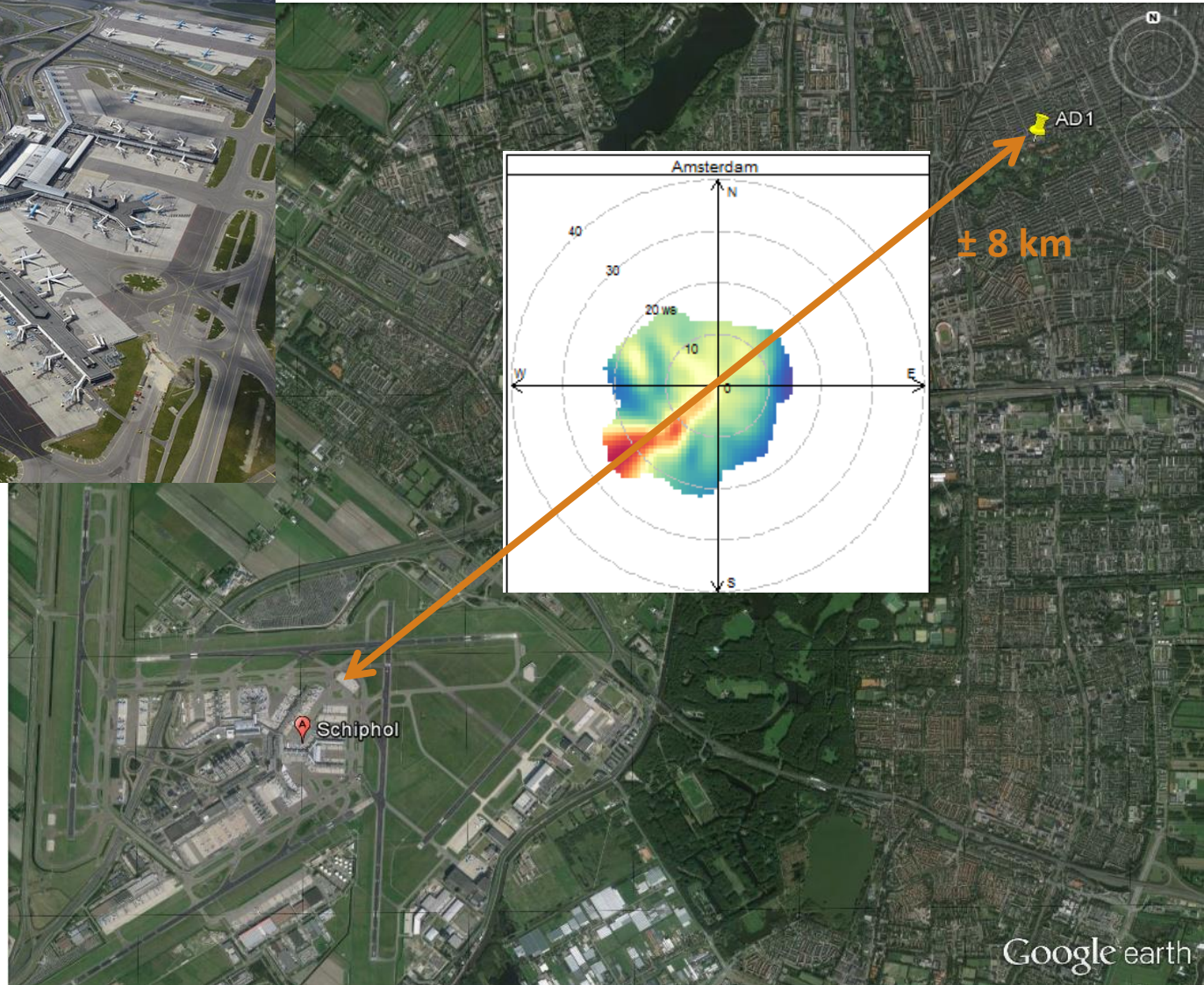
- half-hourly/daily-averaged UFP
 - ✓ Half-hourly/daily TNC ~ PM₁₀, PM_{2.5}, **NO₂**, **NO** and **BC**.
 - ✓ No relations between PNC and PM₁₀/PM_{2.5}
 - ✓ Antwerp! → traffic?
 - ✓ Amsterdam → no clear relation → LEZ/other UFP sources?



Effect of wind speed and direction

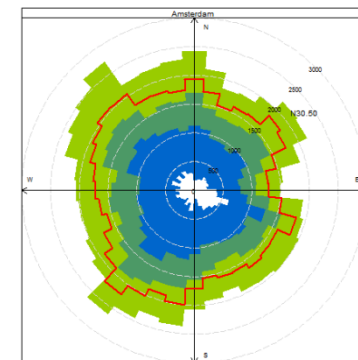
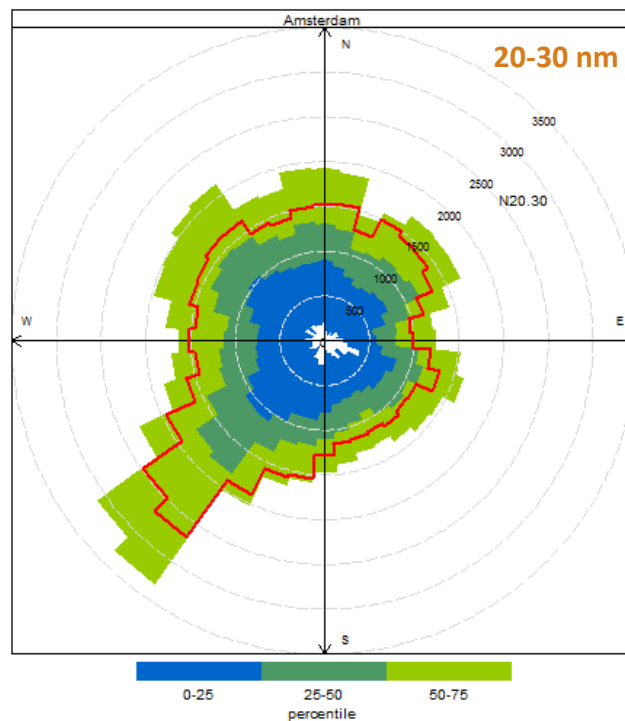
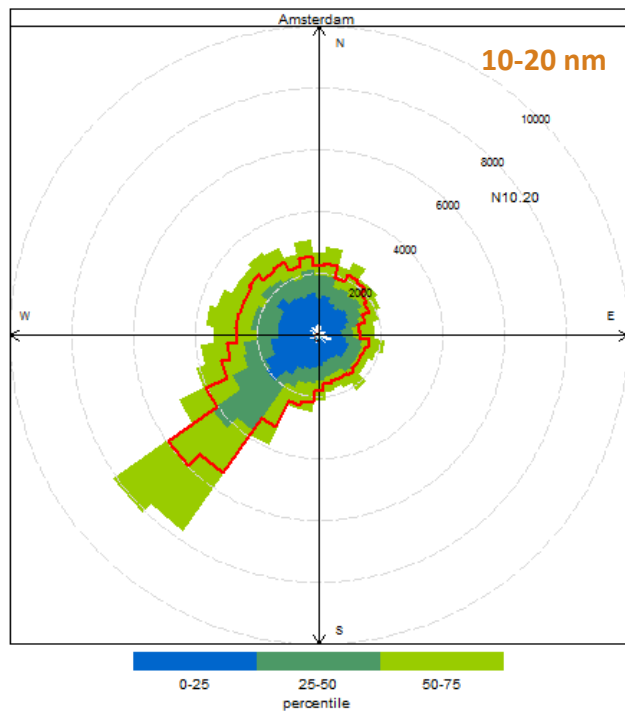


Wind effect on total PNC Amsterdam

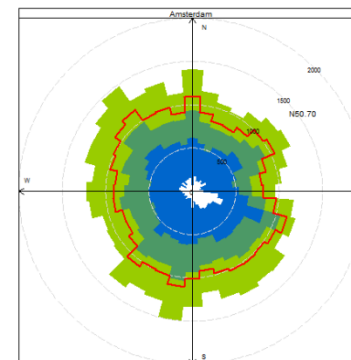


Wind effect on size distribution Amsterdam

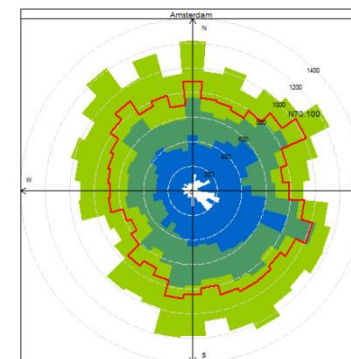
- Dominated by 10-20 nm size range
 - Comparable to *Keuken et al. 2015*
 - Factor 3 at 7 km
 - 20% at 40 km



30-50 nm

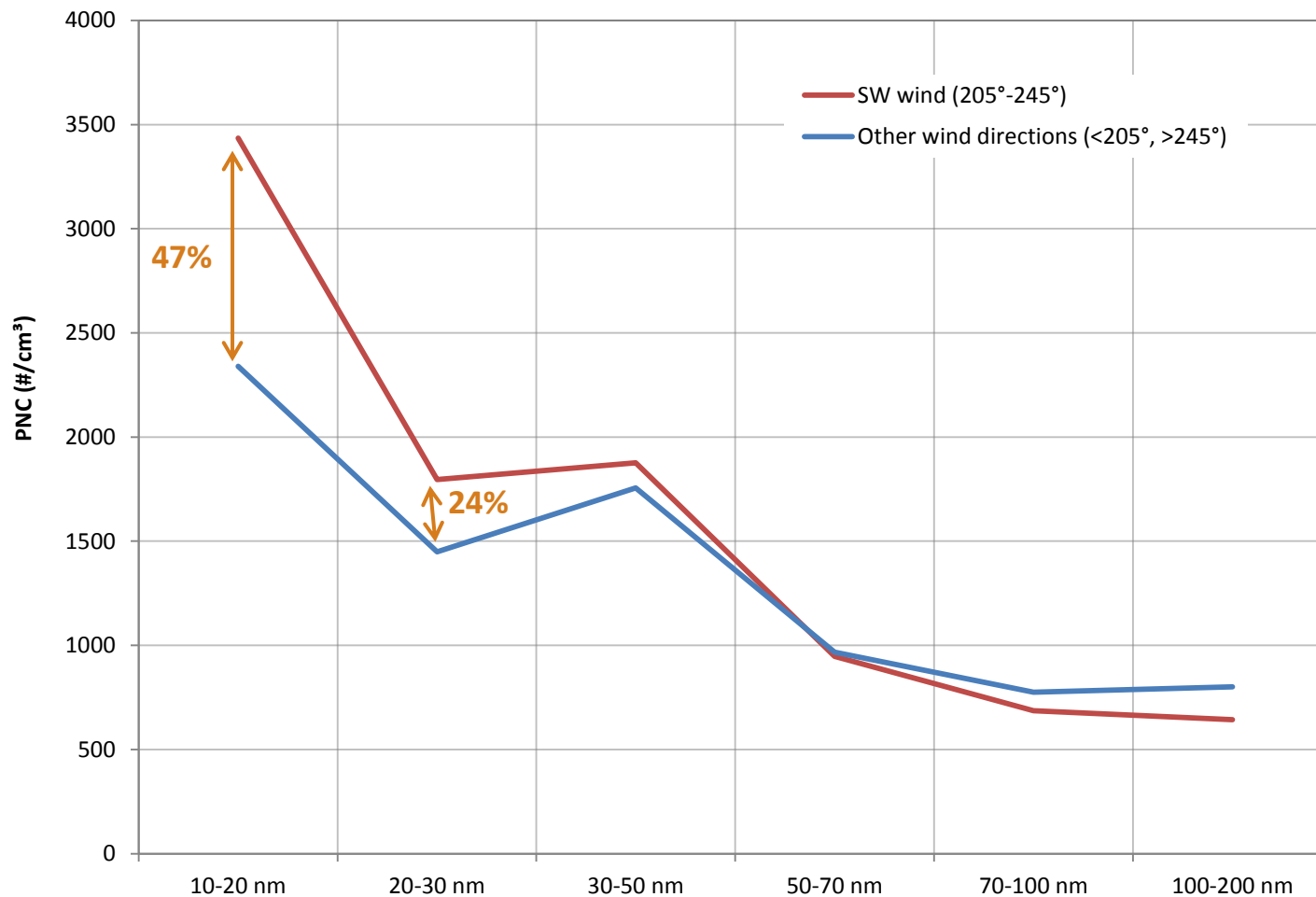


50-70 nm

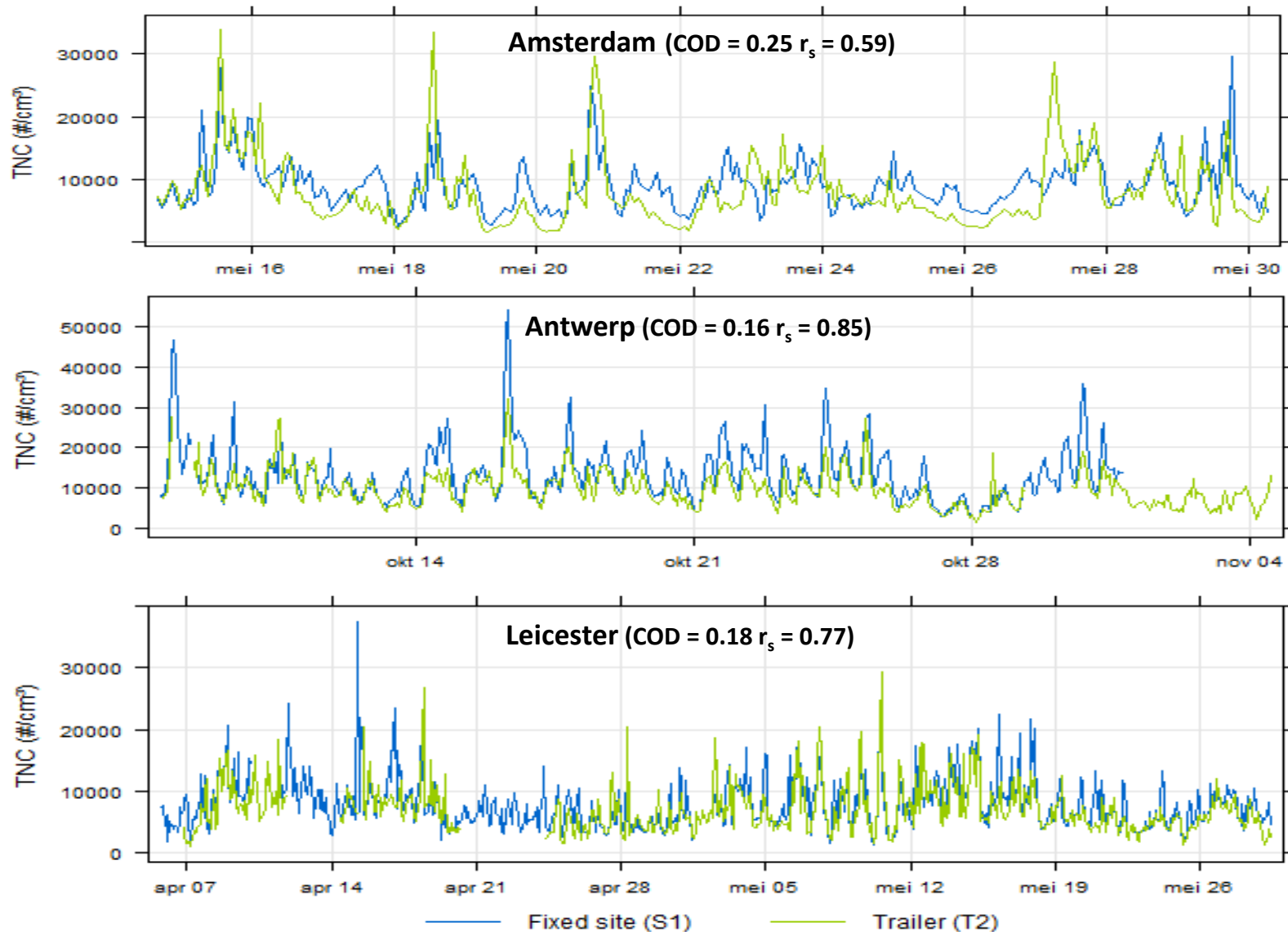


70-100 nm

Wind effect on size distribution Amsterdam



Intra-urban variation: temporal



Intra-urban variation: absolute numbers

Amsterdam

TNC: 39%

PNC: 14-48%

Antwerp

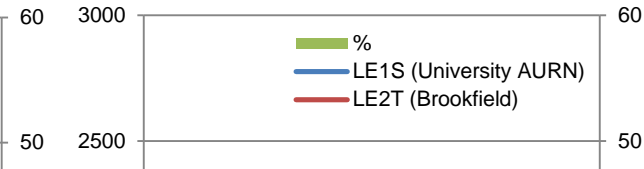
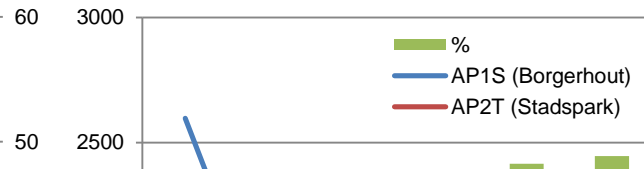
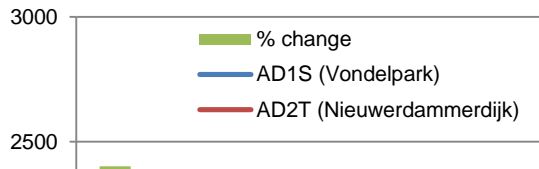
TNC: 43%

PNC: 28-49%

Leicester

TNC: 23%

PNC: 6-30%



Conclusions

- Conclusions
 - ✓ Long-term UFP monitoring network → feasible!
 - TNC → idea
 - Size-resolved UFP → contributing emission sources/spatial scales
 - ✓ Comparable UFP size distributions for 4 “urban background” sites
 - ✓ Relations with other pollutants (e.g. BC, NO₂): site-dependent
 - Traffic!
 - Schiphol airport → smaller-sized UFP
 - ✓ Intra-urban UFP variation in absolute numbers (e.g. Antwerp)
- Outlook

What is a good urban background station?

Collecting representative air quality data remains challenging!