



VLAAMSE MILIEUMAATSCHAPPIJ

Air Quality Monitoring of Black, Elemental and Organic Carbon in Flanders

London 12th and 13th December 2011

Christine Matheussen

Air Quality Monitoring of Black, Elemental and Organic Carbon in Flanders

- EC / OC (OM) measurements in PM10 Chemical Characterisation Projects
- Contribution of wood burning to OM and PM10
- BS and BC measurements in the monitoring networks
- Conclusions

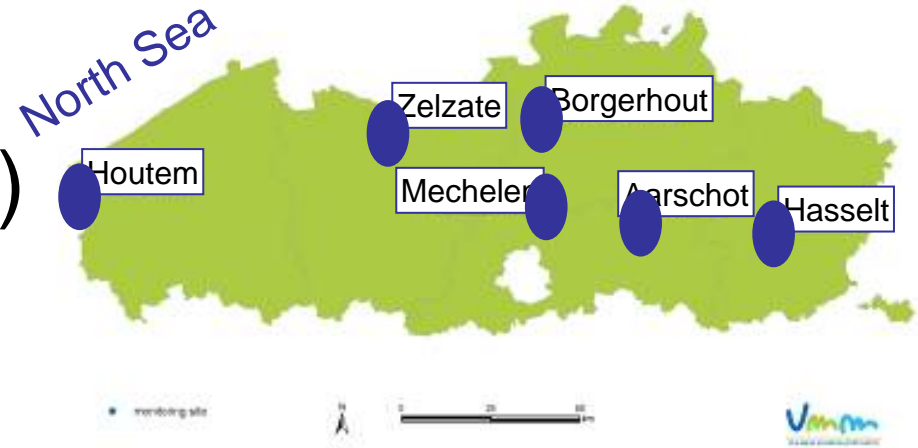


EC/OC (OM) in PM10 Chemical Characterisation Projects

1 st	2006-2007	6 places: rural/urban/suburban/industrial
2 nd	2008-2009	9 places : 6 hot spots + 3 rural
3 th	2010-2011	11 places : 7 wood burning , 3 hot spots, 1 rural
4 th	2011-2012	12 places : urban background, traffic, major road in 4 cities

1st PM10 chemical characterisation project Sep 2006-Sep 2007

- 6 sites
- Every 6th day (= 61d)
- EC/OC (TOT-NIOSH, UGent)
- 1st large scale PM project in Flanders



Houtem
Rural

Zelzate
Industrial

Mechelen
Suburban

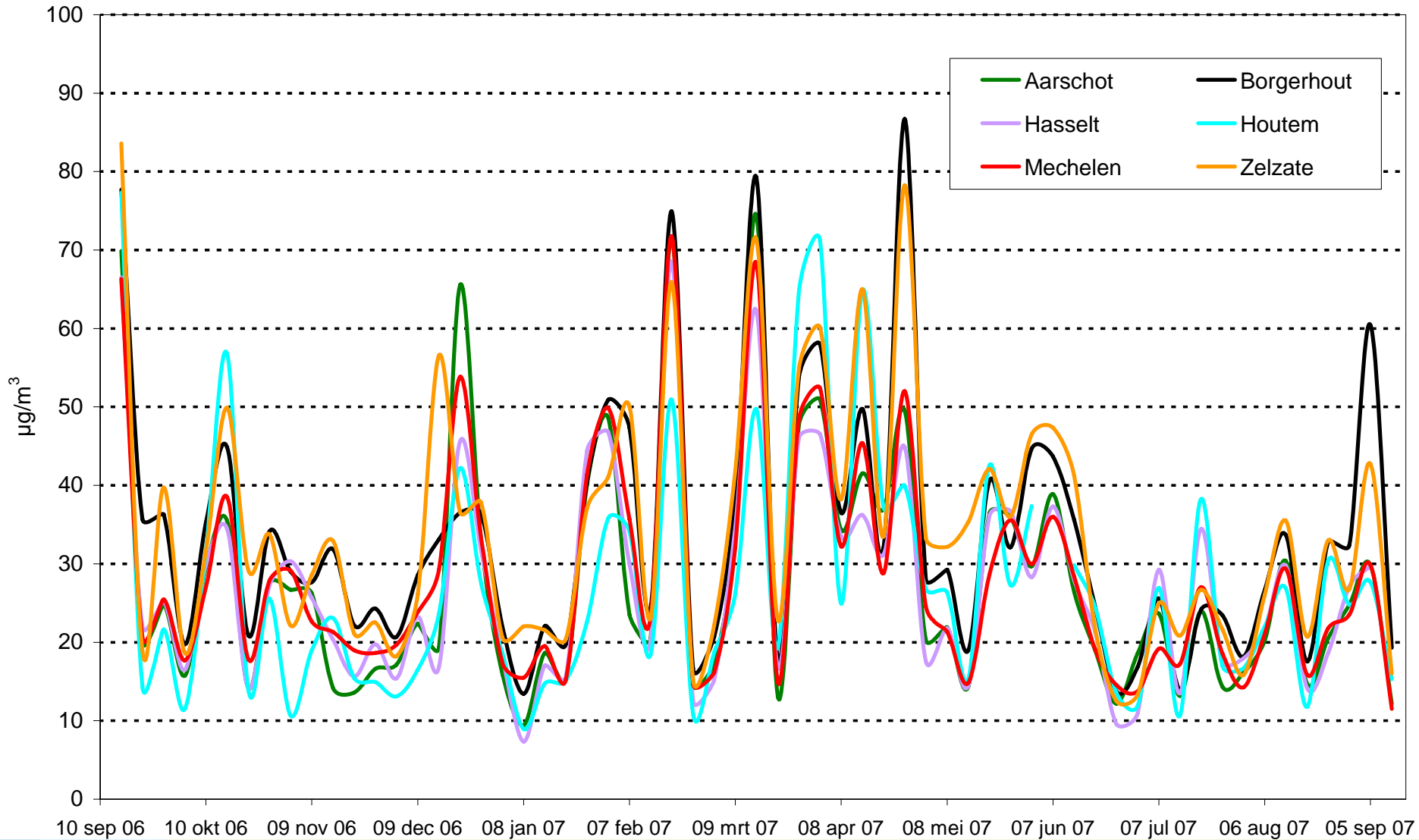
Borgerhout
Urban

Aarschot
Rural

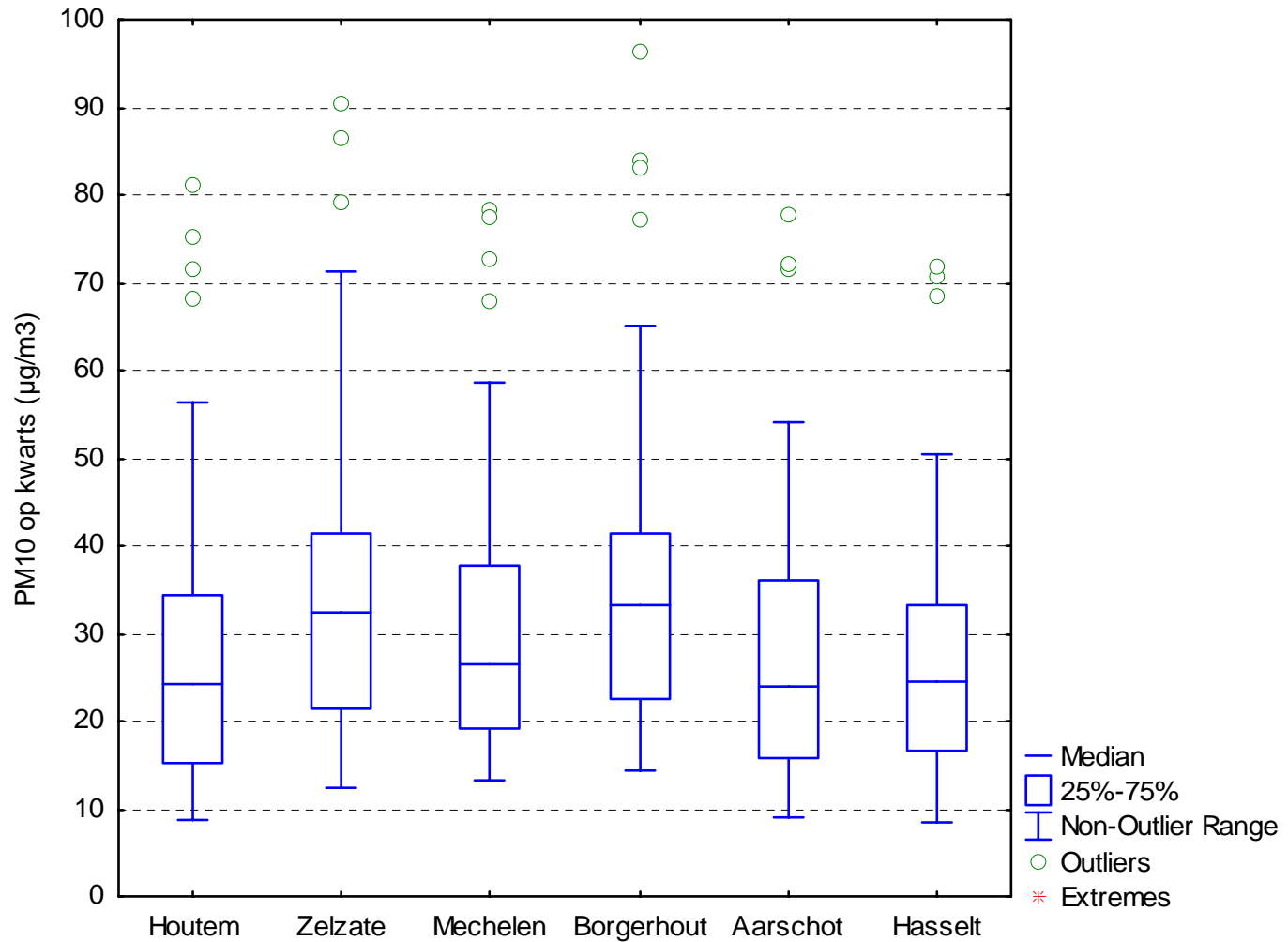
Hasselt
Suburban



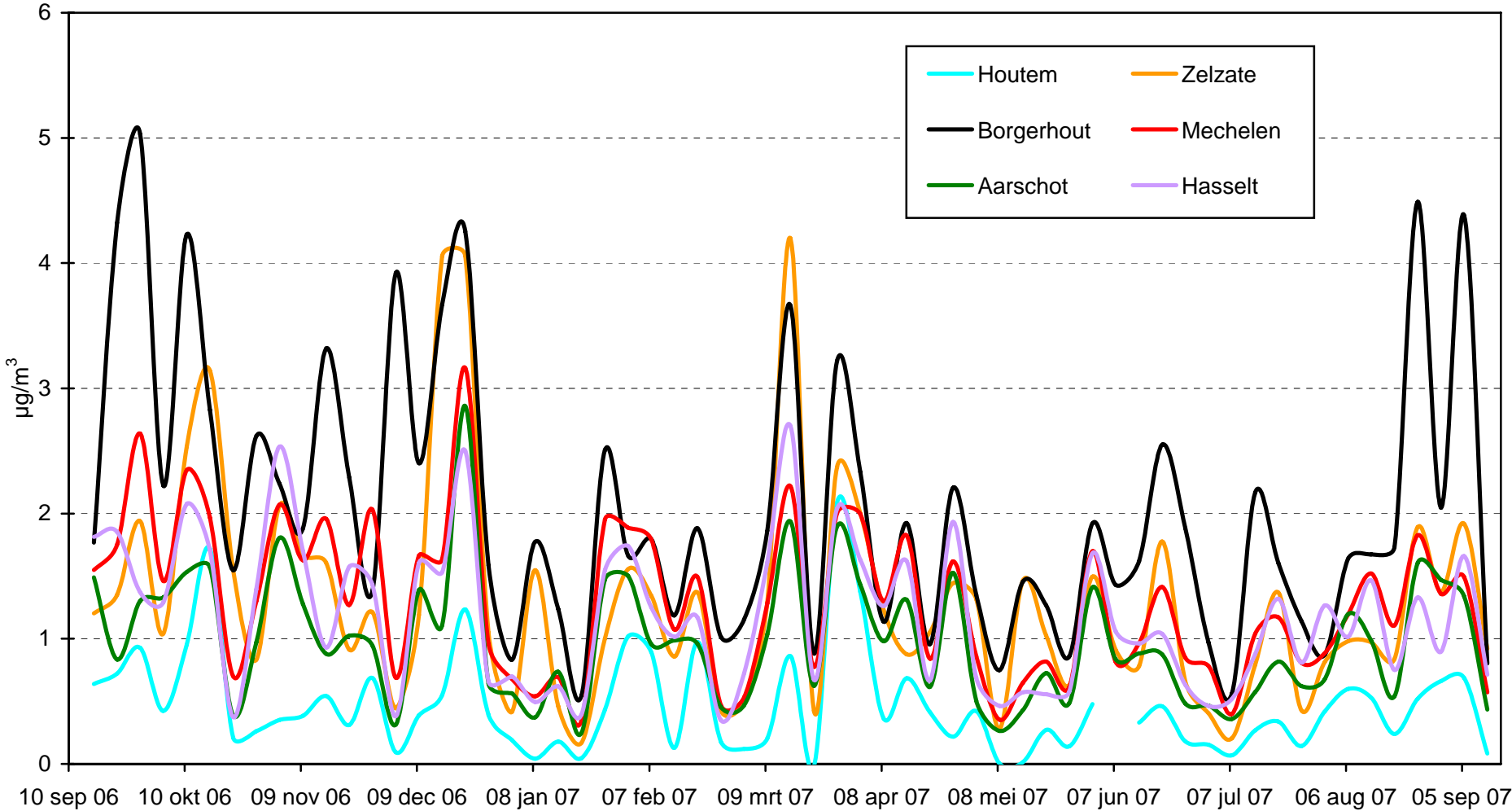
PM10 concentrations ($\mu\text{g}/\text{m}^3$)



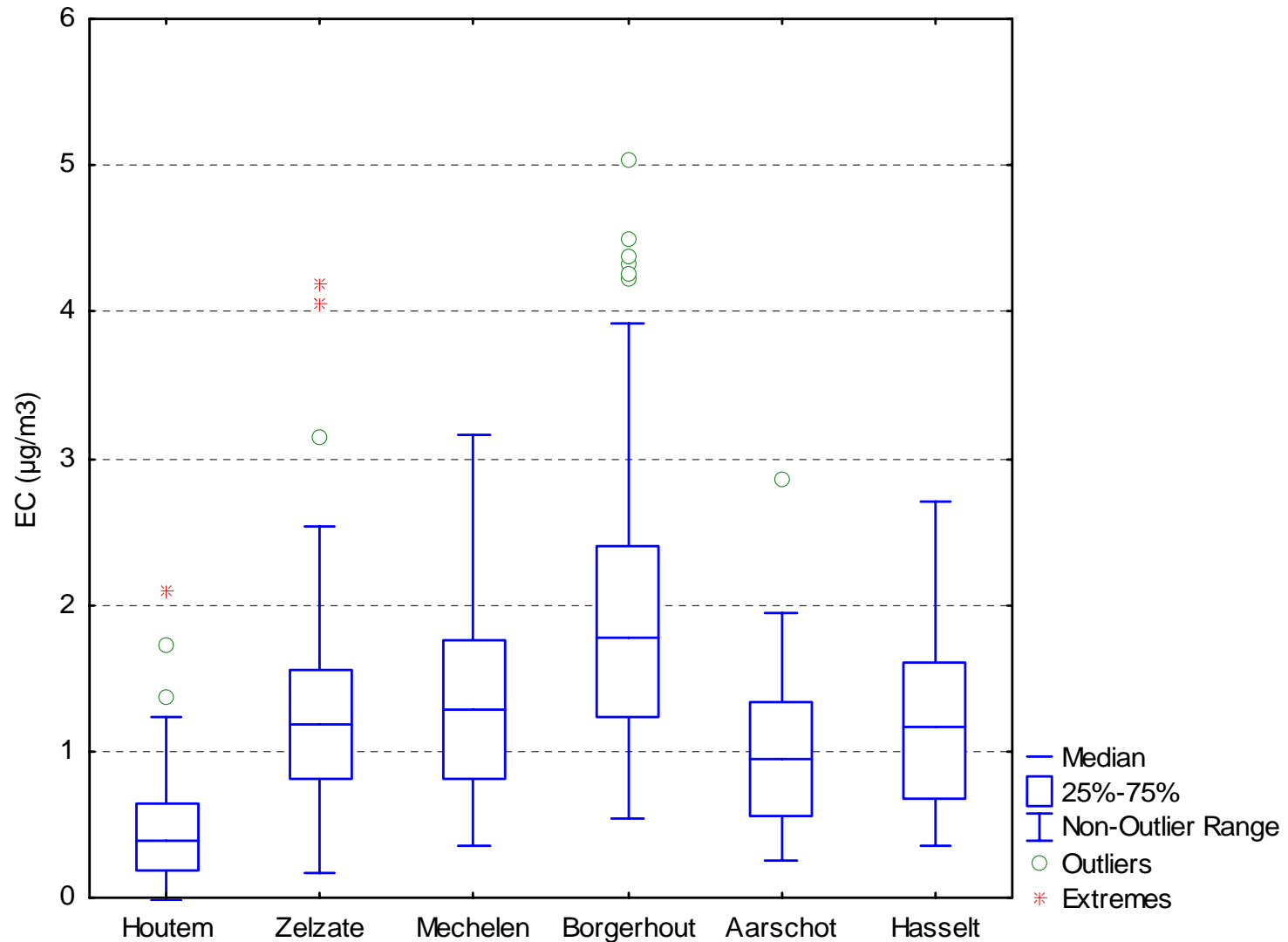
PM10 concentrations at the different locations ($\mu\text{g}/\text{m}^3$)



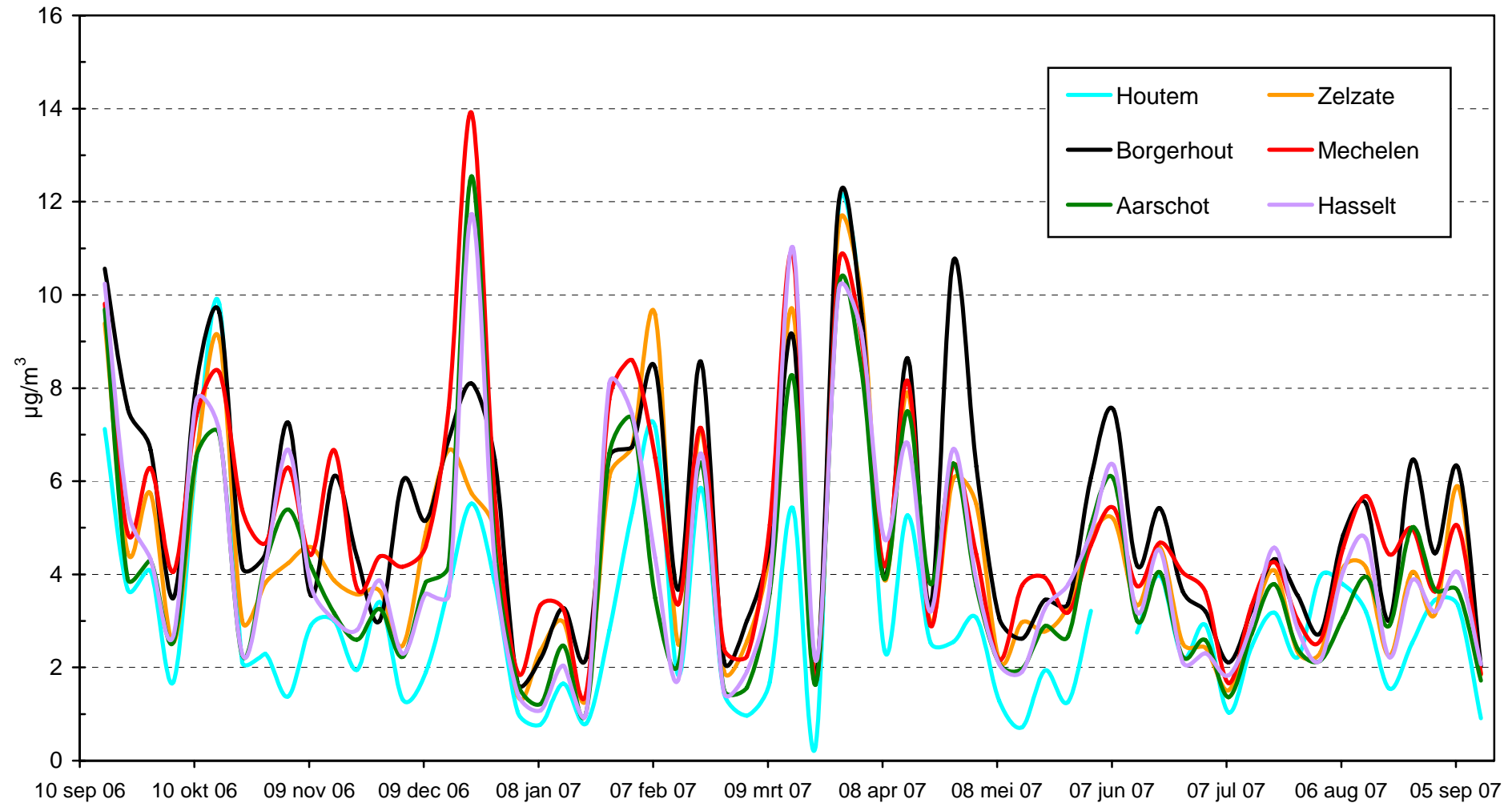
EC concentrations ($\mu\text{g}/\text{m}^3$)



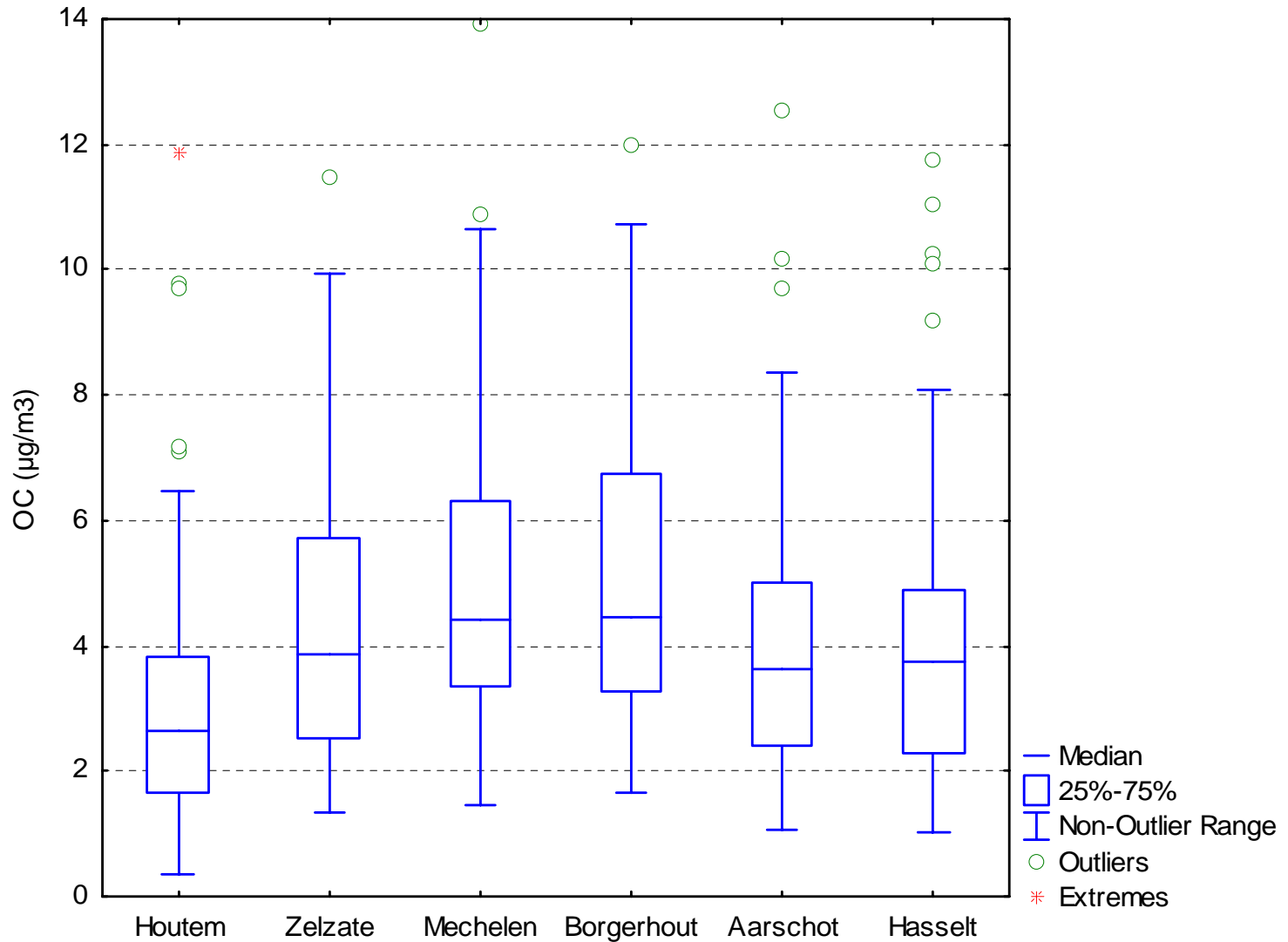
EC concentrations at the different locations ($\mu\text{g}/\text{m}^3$)



OC concentrations ($\mu\text{g}/\text{m}^3$)



OC concentrations at the different locations ($\mu\text{g}/\text{m}^3$)



“Average” composition

1. Secund. inorg. ions (=NO₃+SO₄+NH₄)

>> 41% (12.6 μg/m³)

2. Organic matter (=1.4 OC)

>> 20% (6.1 μg/m³)

3. Crustal matter

(=2.2 Al+2.5Si+1.6Ca+2.4Fe+1.9Ti)

>> 14% (4.3 μg/m³)

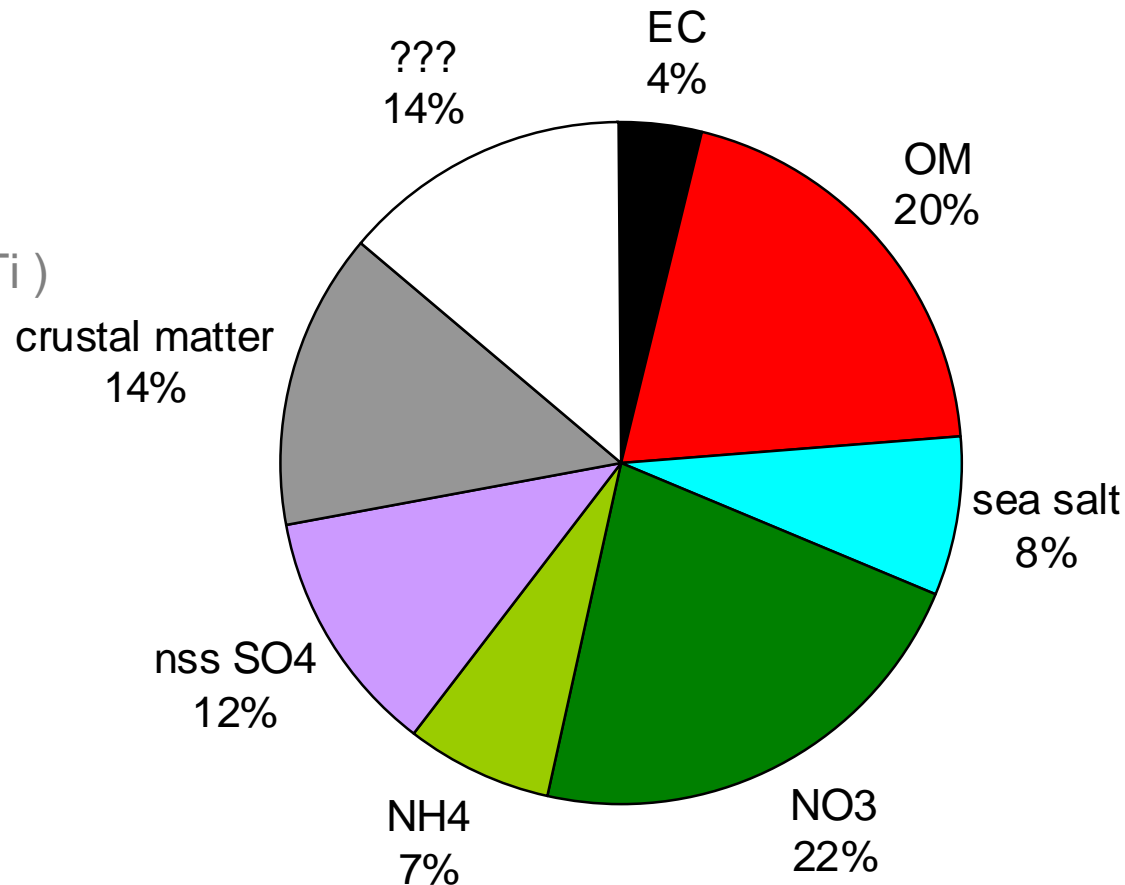
4. Sea salt (1.45Na⁺ + Cl⁻)

>> 8% (2.4 μg/m³)

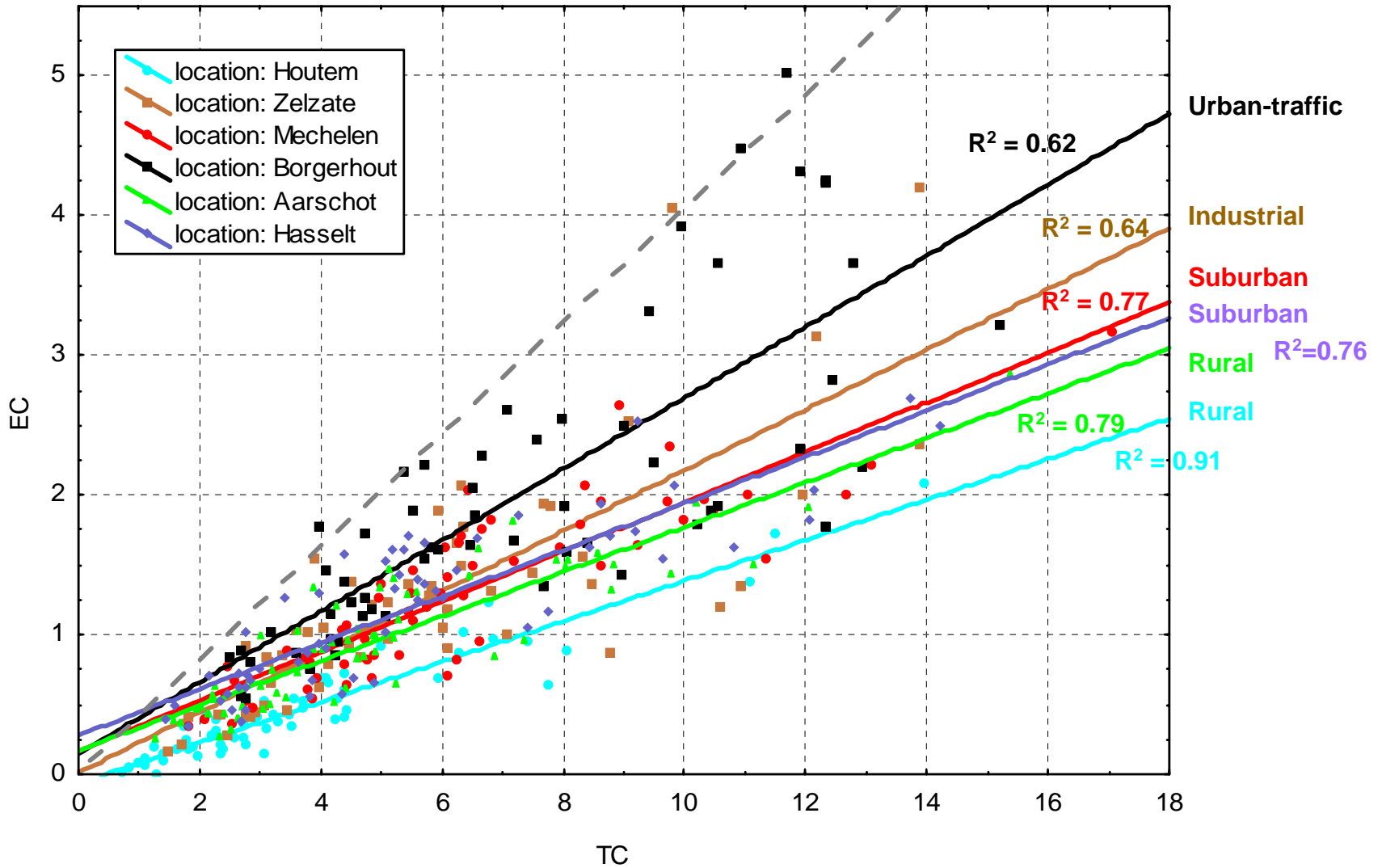
5. Elementary carbon

>> 4% (1.2 μg/m³)

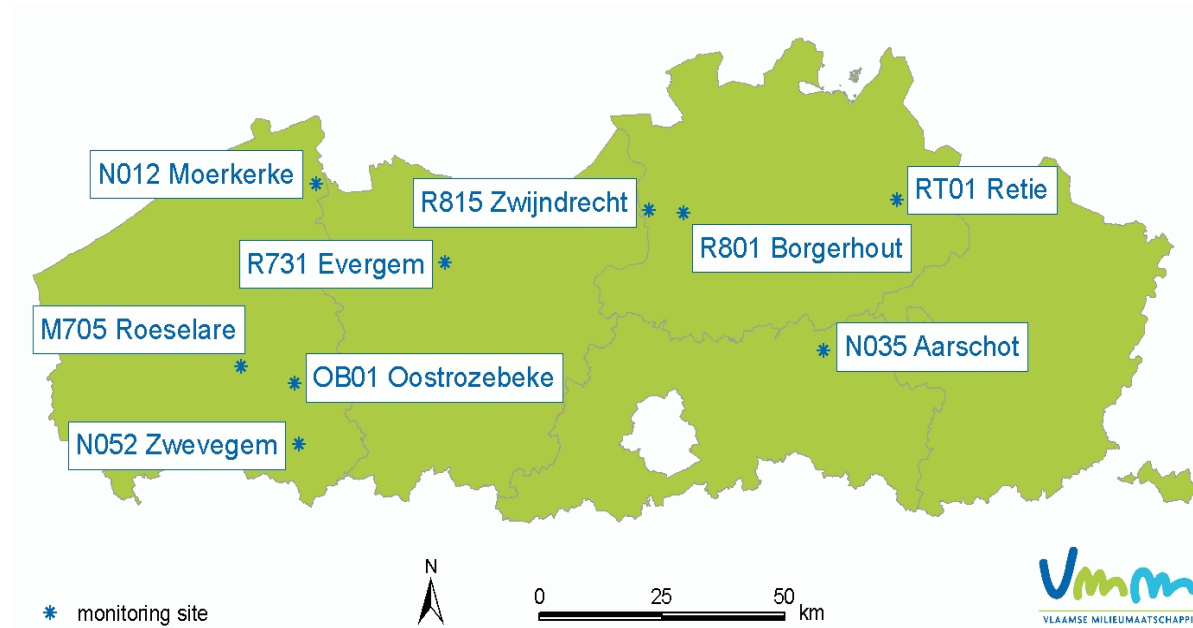
Σ 31 μg/m³



EC vs TC ($\mu\text{g}/\text{m}^3$)

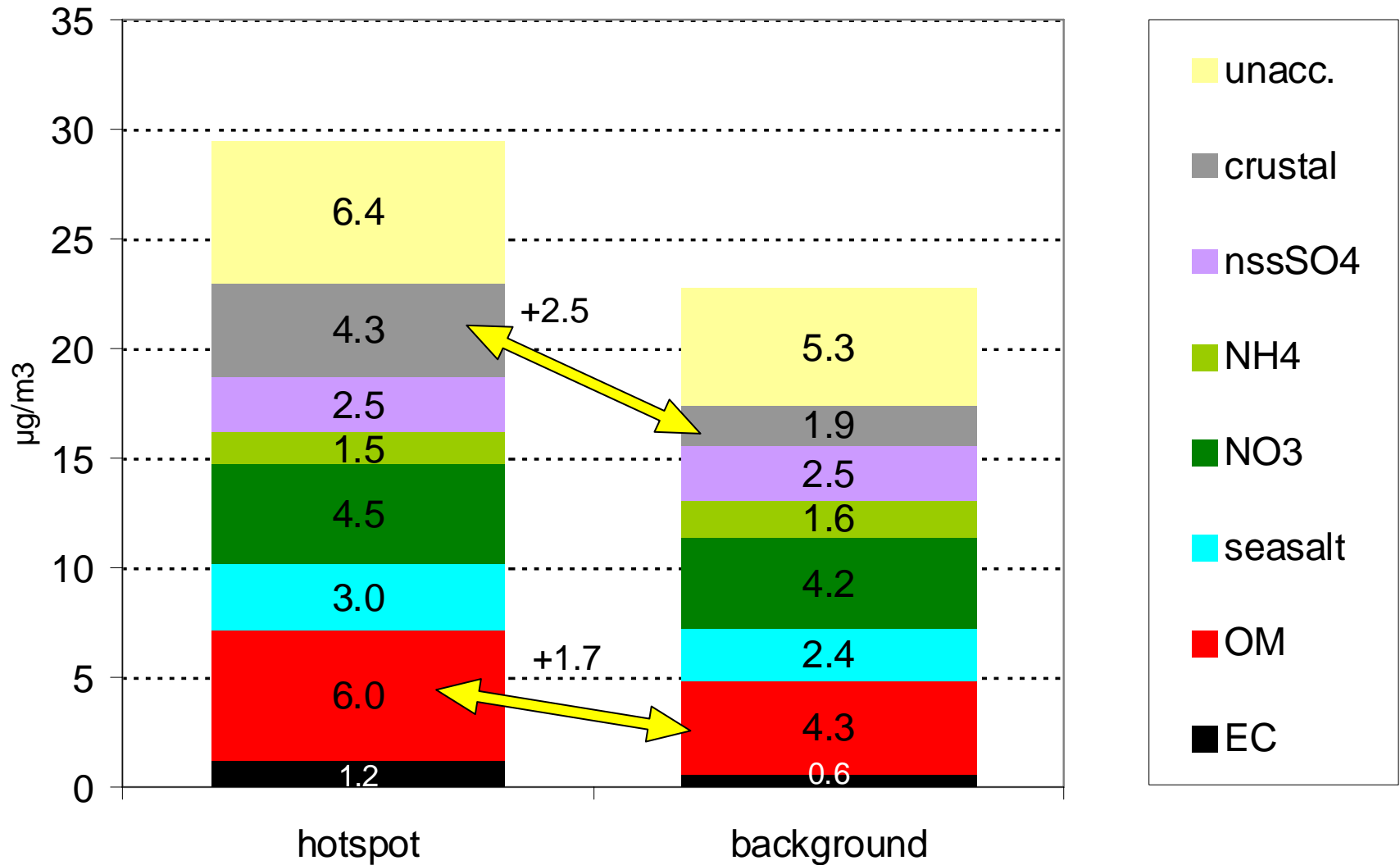


2th PM10 chemical characterisation project



- 9 sites : 6 hotspots + 3 “background”
- Every 6th day (= 61d x 6)
- EC/OC (TOT-NIOSH, UGent)

What is the difference between hot spot and background ?



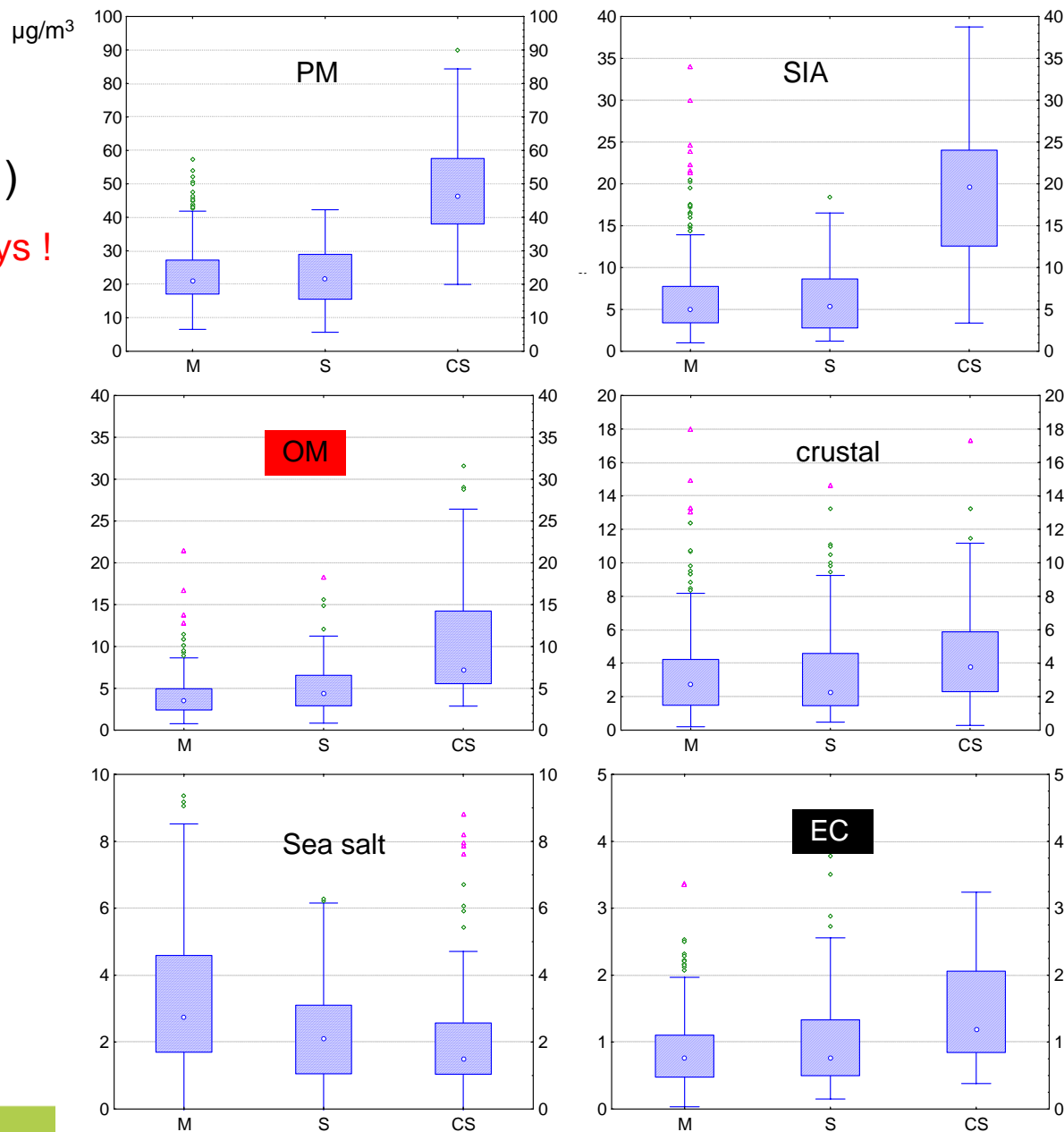
Effect of air mass origin on PM levels

Marine (#35)

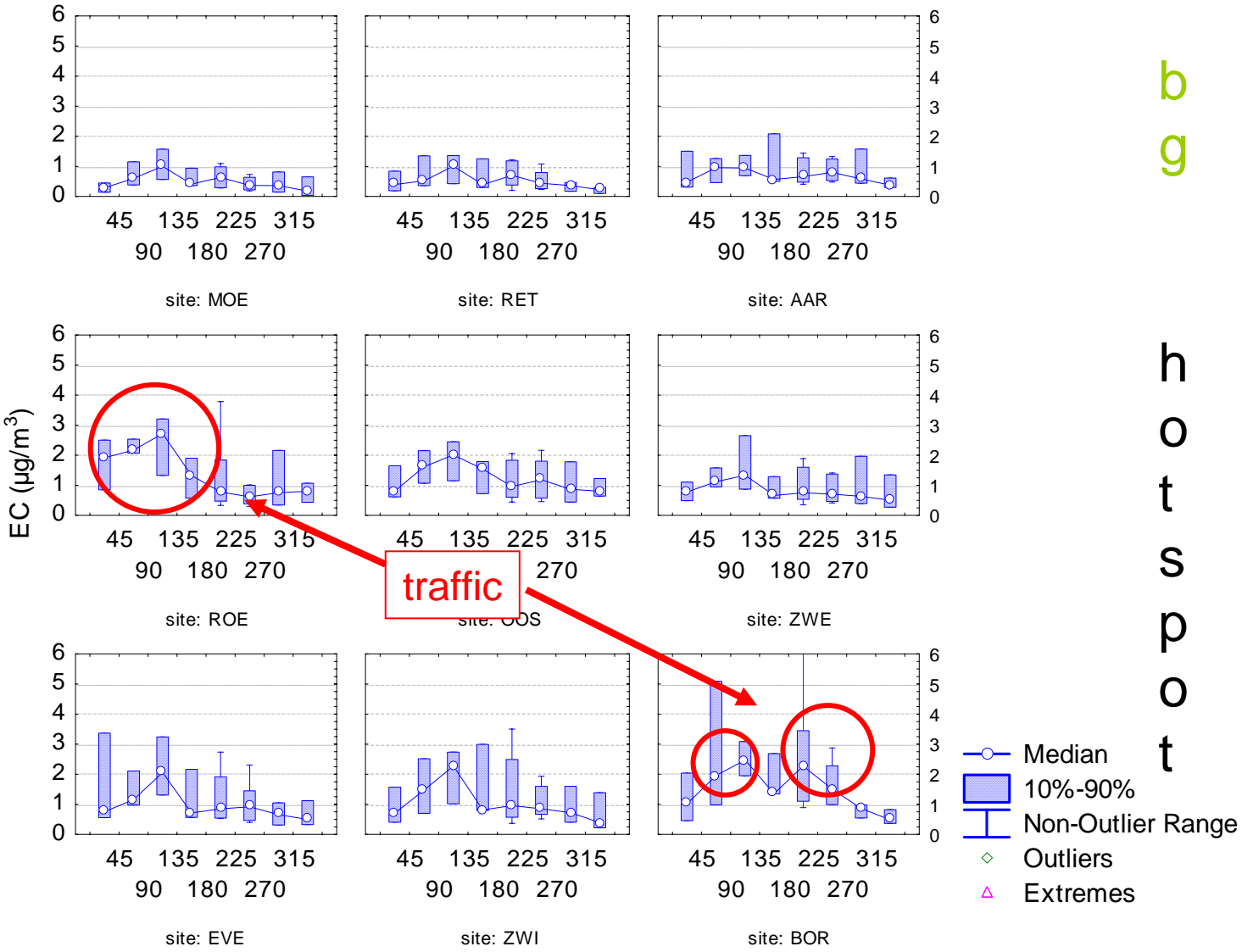
Southerly (#15)

Continental/Stationary (#11)

>> 98% of exceedance days !



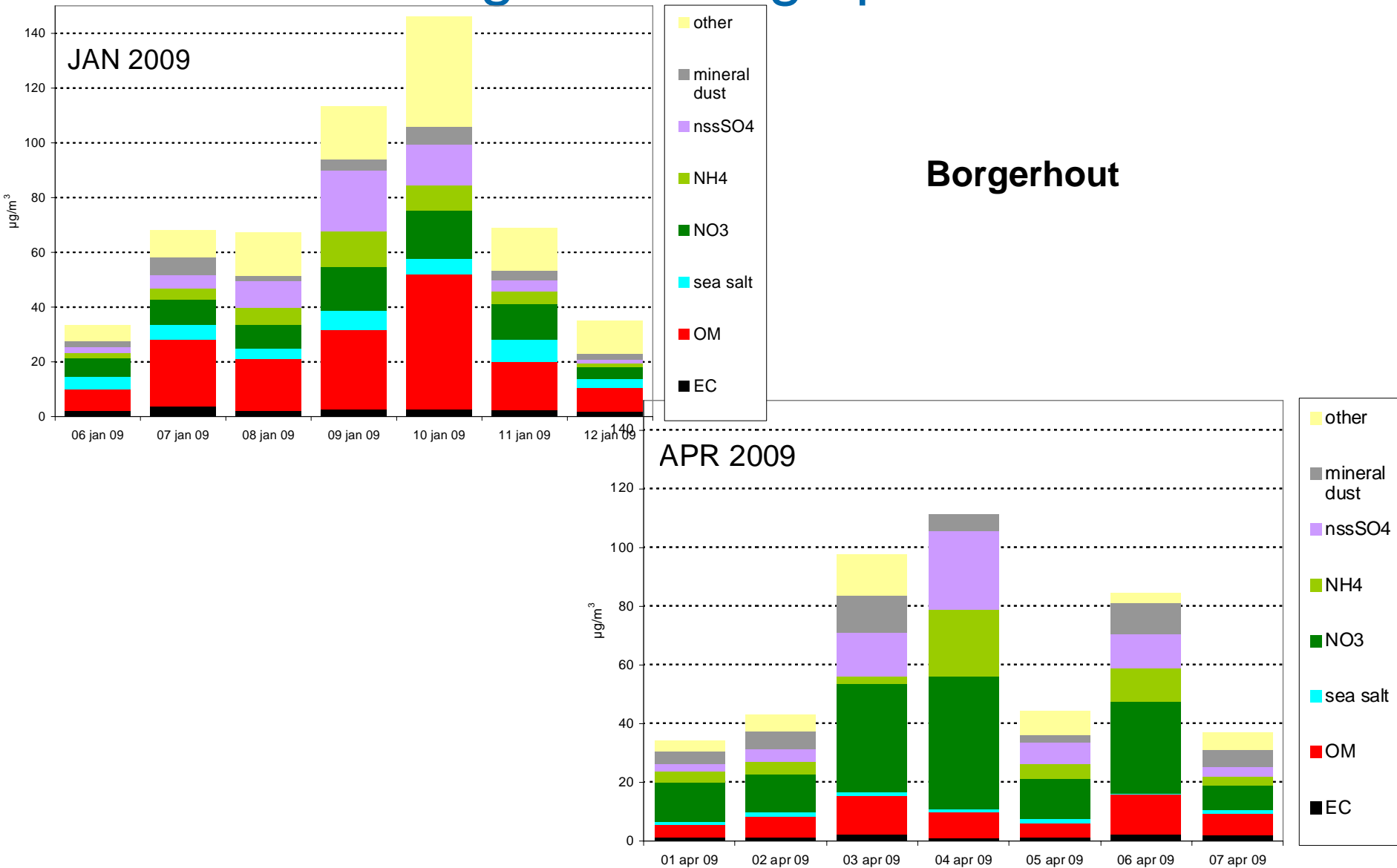
EC concentration for the different wind sectors



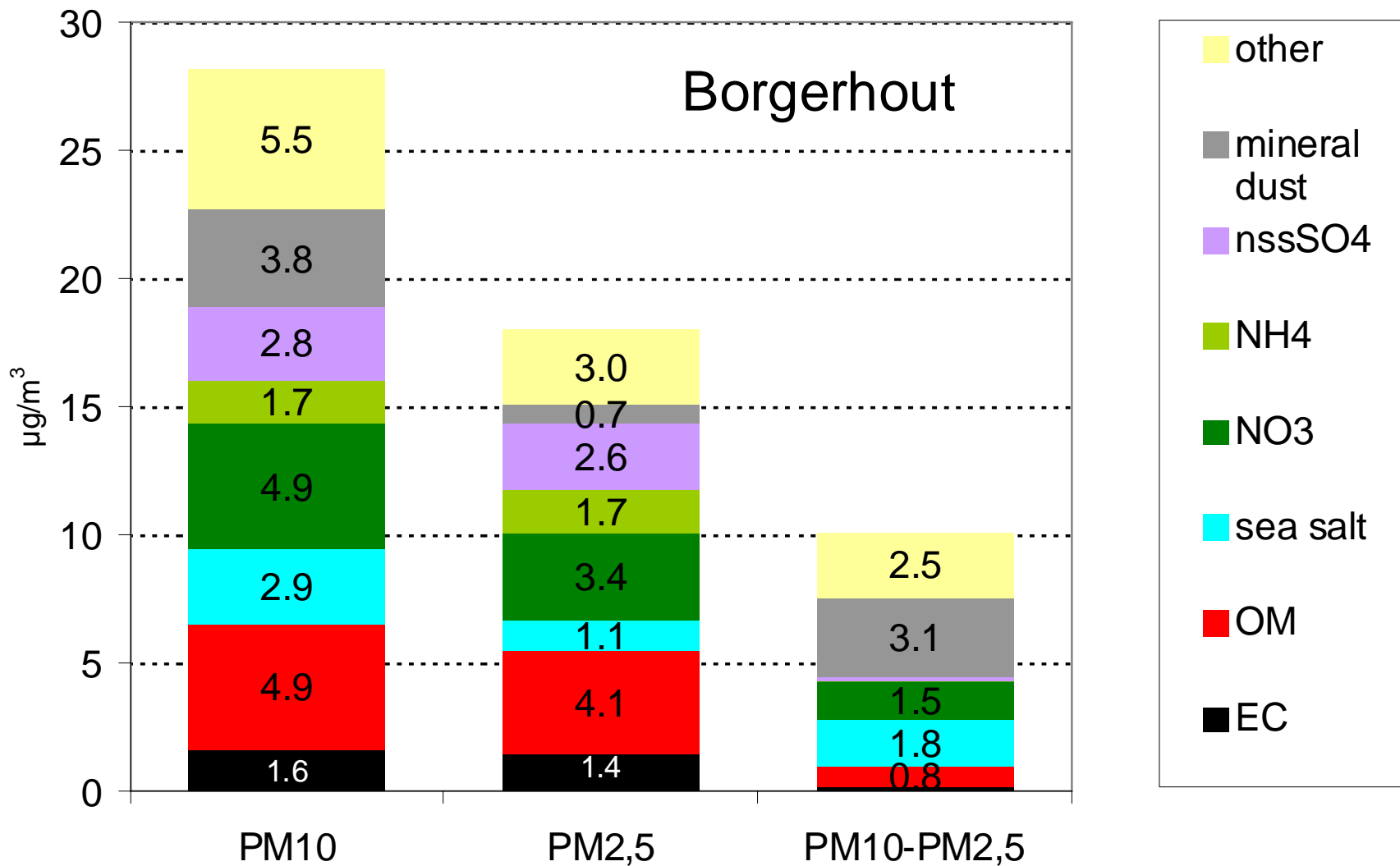
b
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Chemical composition of PM10 during two smog episodes



Average composition of PM10, PM2,5 and PM10-PM2,5

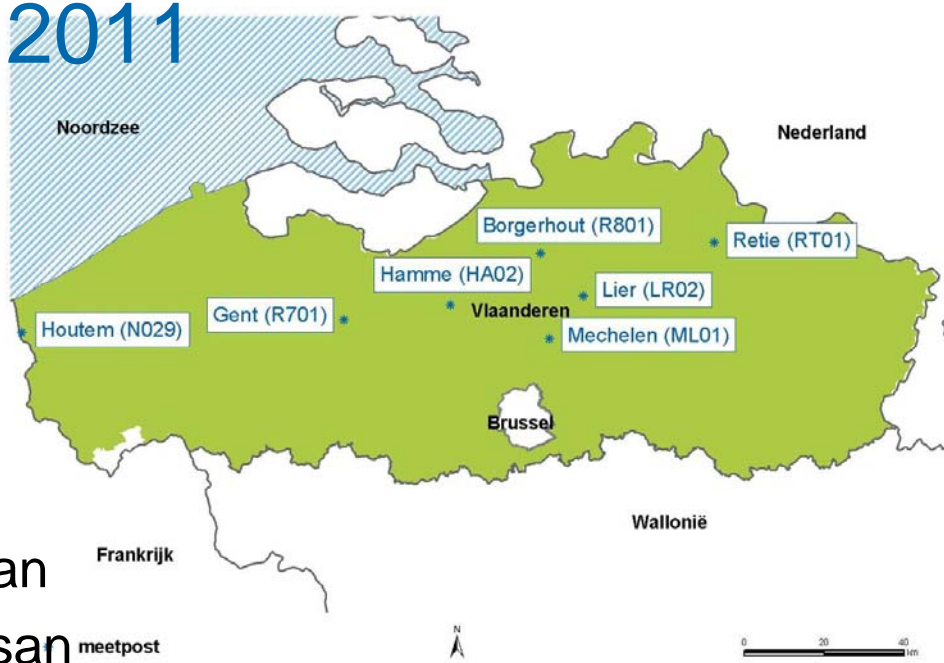


EC/OC and levoglucosan in 3th PM10 chemical characterisation project Feb 2010- Feb 2011

- 7 sites
- Every 4th day (= 92d x 6)
- EC/OC (TOT-NIOSH, UGent)
- Levoglucosan
(GC/MS after derivatization, UGent)

OM (wood) = 9.1 * levoglucosan

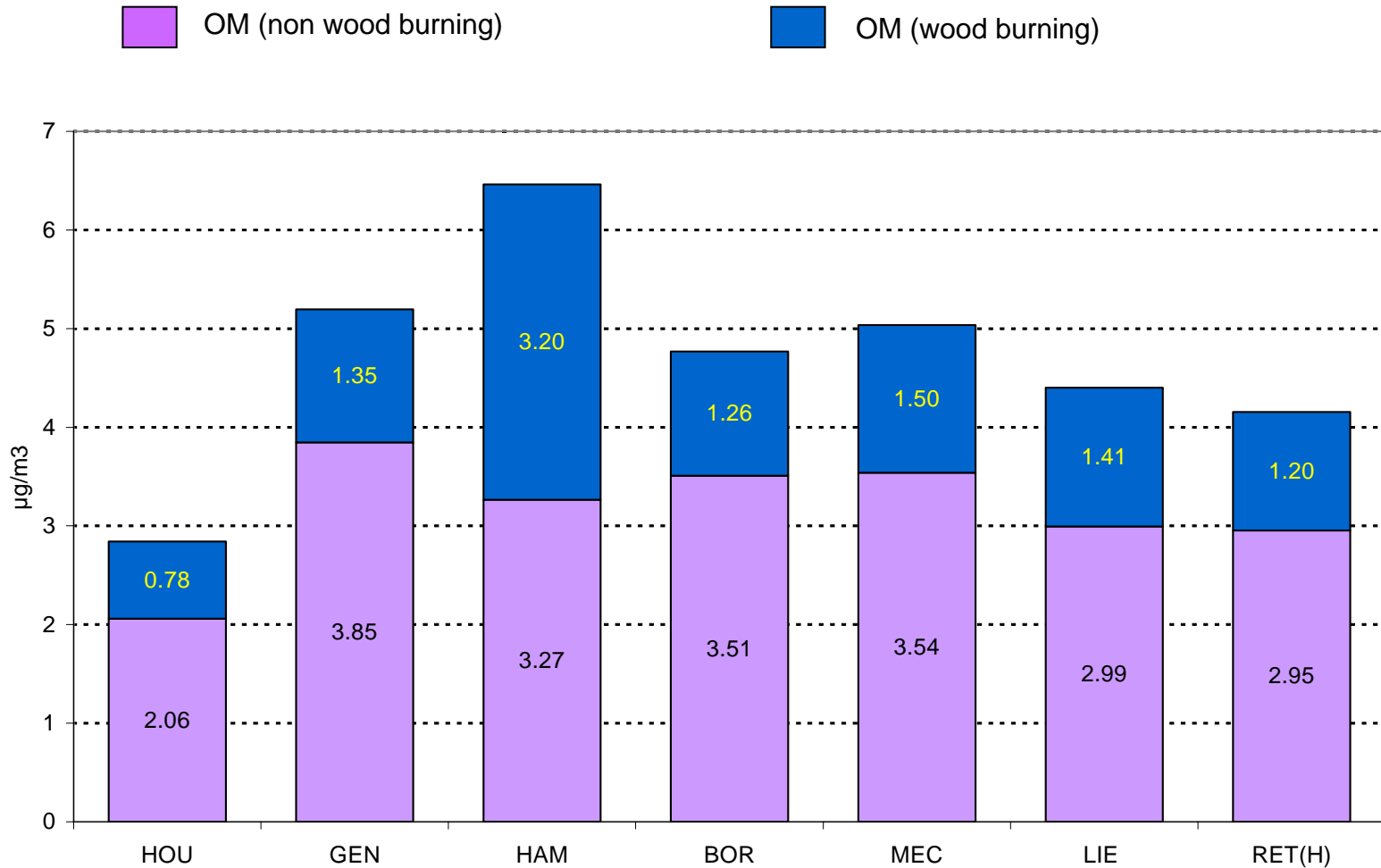
PM (wood) = 10.7 * levoglucosan



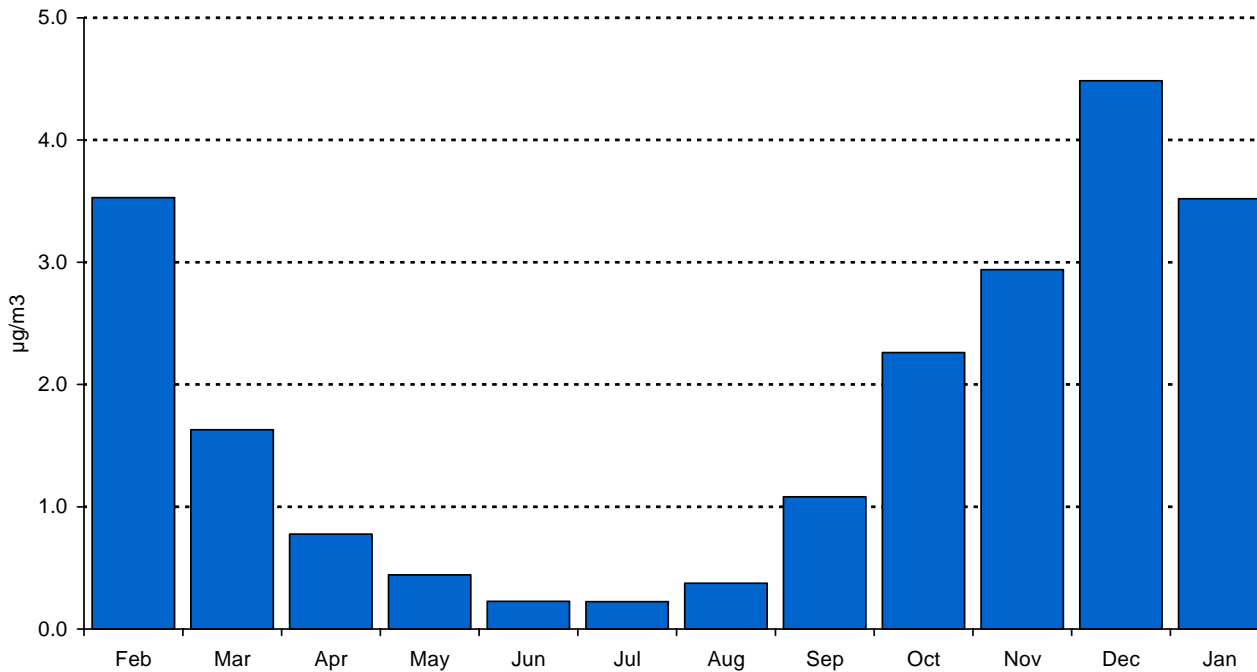
Rural Urban Rural (sources) Urban Suburban Rural (sources ?) rural



Contribution of wood burning to organic matter in PM10

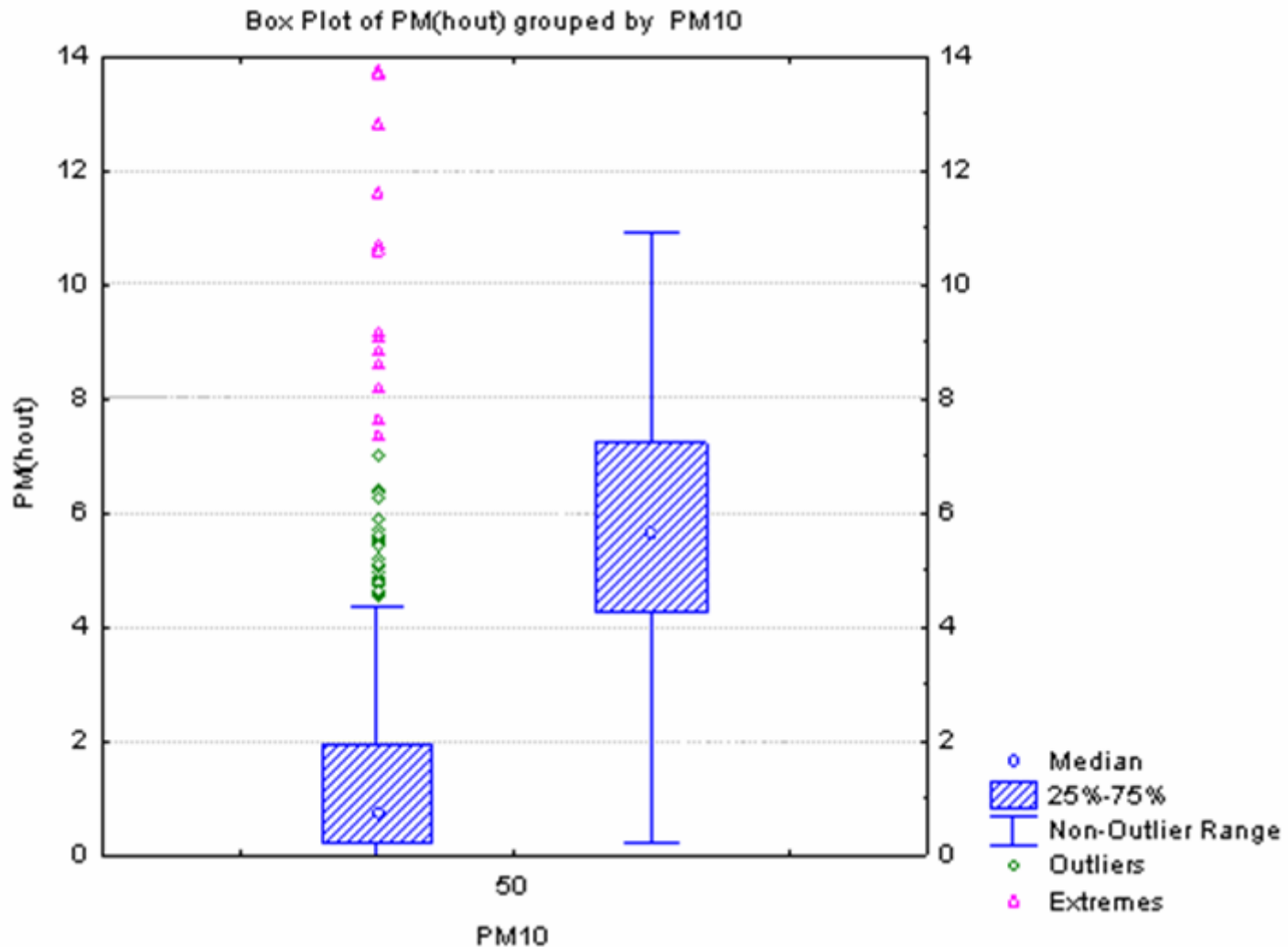


Average contribution of wood burning to PM10 per month, all sites together

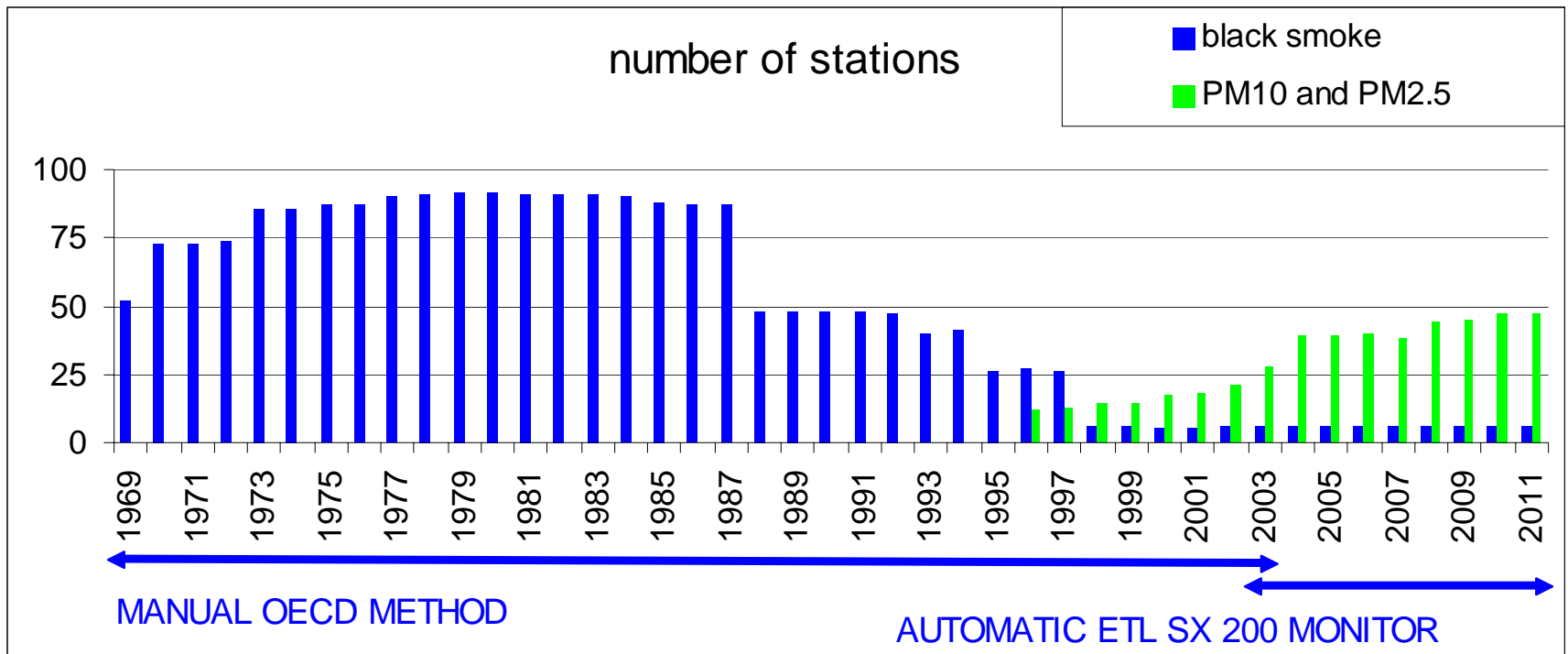


µg/m ³	All year		Summer (Apr-Sep)		Winter (Oct-March)		Winter/Summer
min	0,92	4,3%	0,16	0,8%	1,7	7,1%	10,6
max	3,76	13,3%	1,45	6,2%	6,0	18,2%	4,1
All stations	1,80	6,9%	0,51	2,3%	3,0	10,6%	5,9

Contribution of wood burning to PM10 on days $< 50 \mu\text{g}/\text{m}^3$ (left) and $> 50 \mu\text{g}/\text{m}^3$ (right)



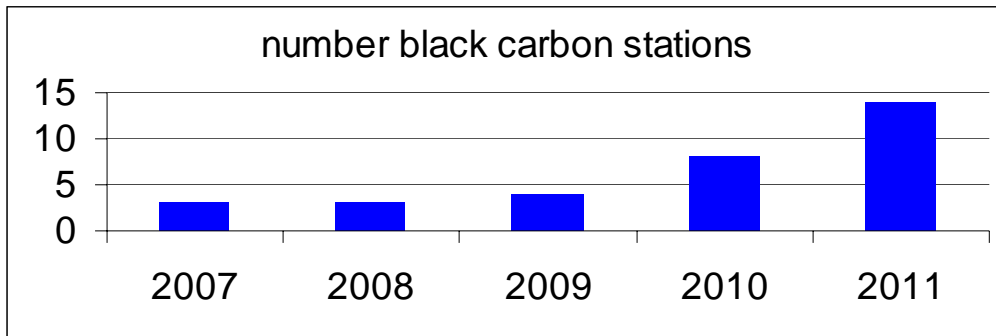
Black smoke measurements



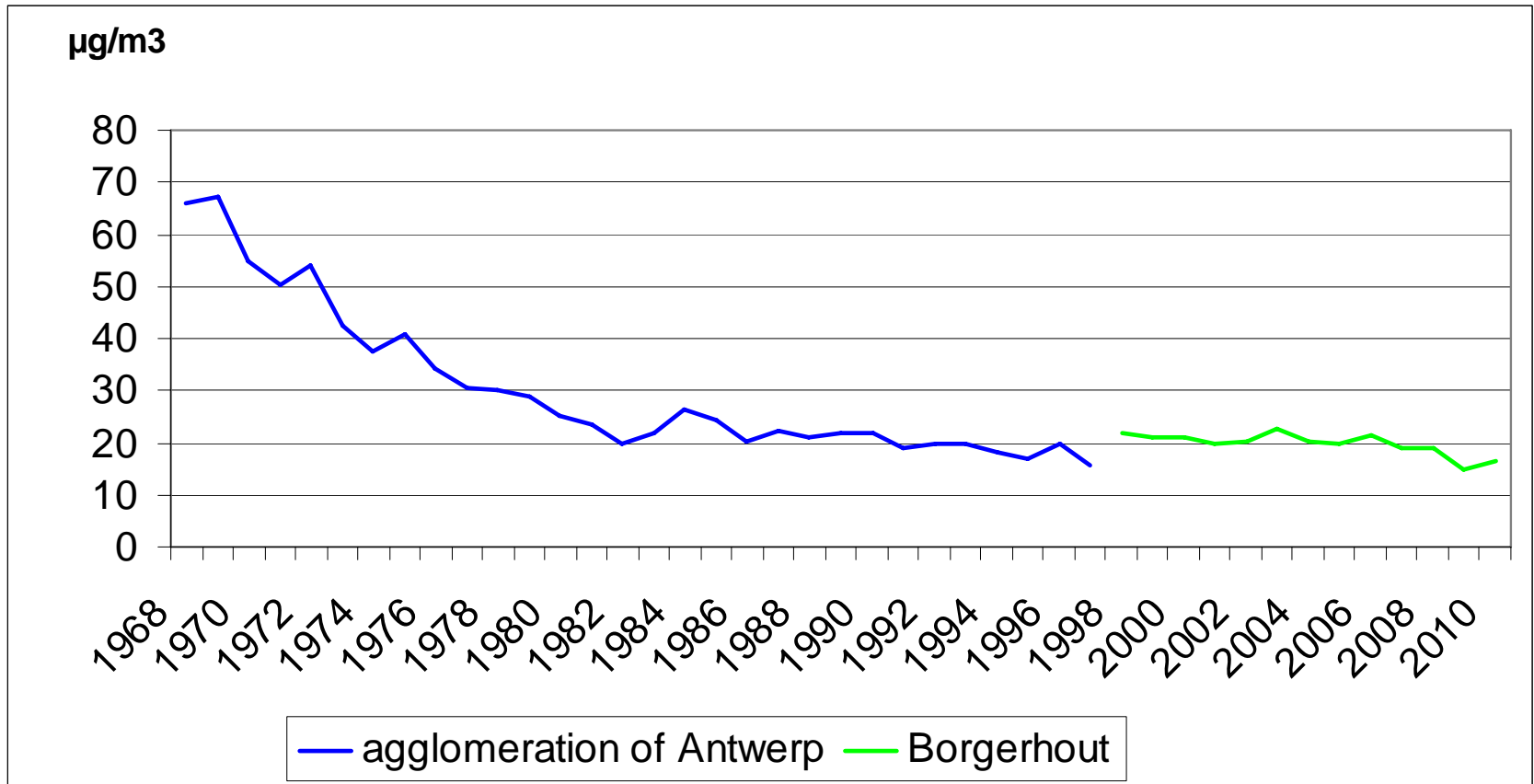
Black smoke stations



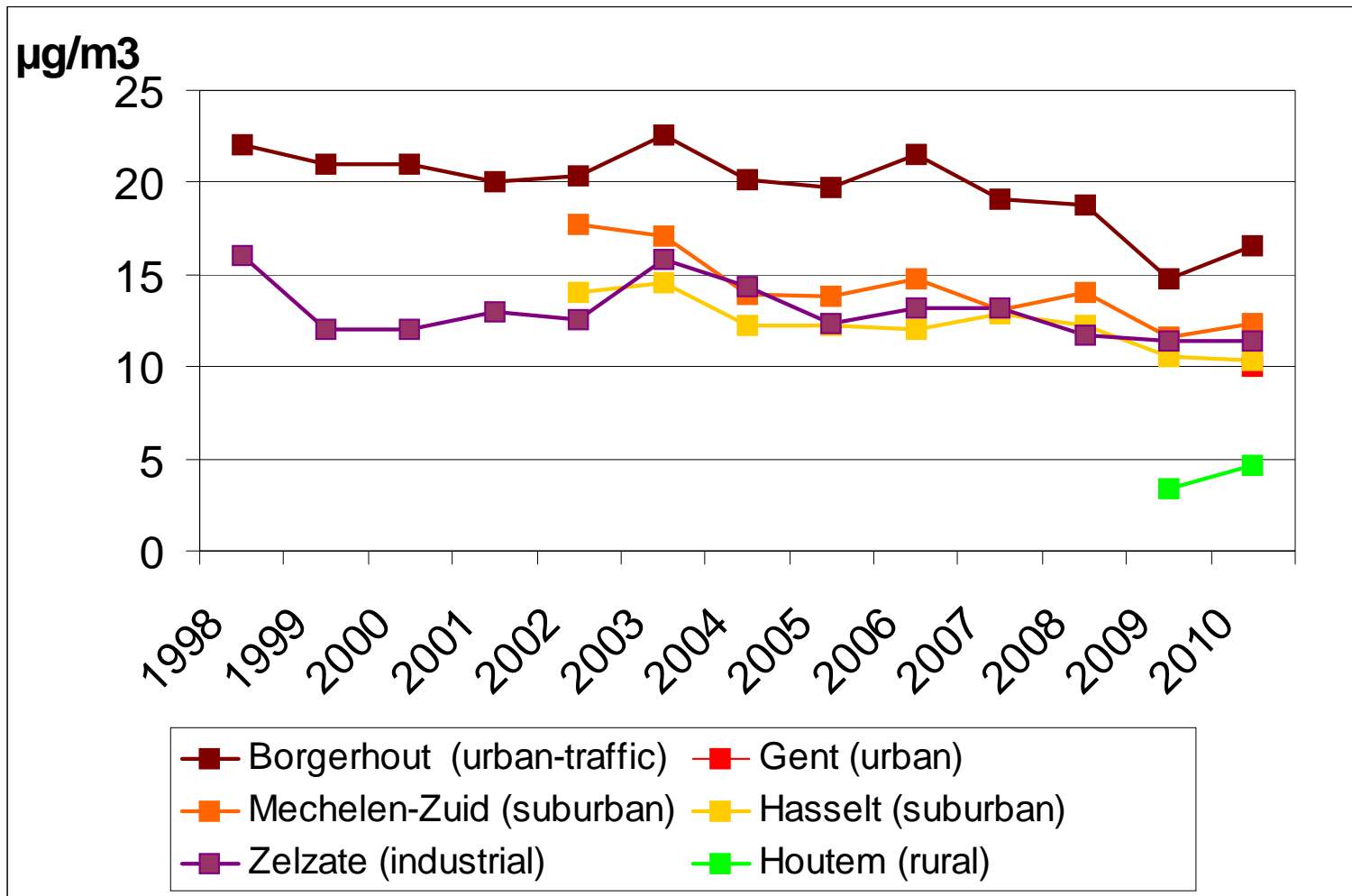
Black carbon stations and measurements



Evolution black smoke 1968-2010



Black smoke measurements since 1998



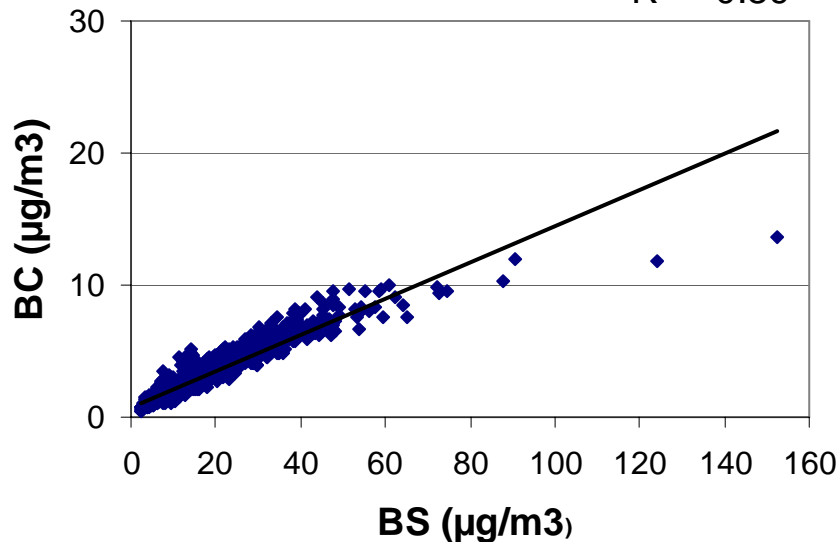
Comparison BC versus BS

	Borgerhout (urban)		Zaventem (airport)	
		R ²		R ²
2007	BC = 0.12*BS + 1.12	0.90	BC = 0.13*BS + 0.84	0.91
2008	BC = 0.13*BS + 0.83	0.87	BC = 0.15*BS + 0.39	0.96
2009	BC = 0.16*BS + 0.76	0.92	BC = 0.16*BS + 0.35	0.98
2010	BC = 0.15*BS + 0.38	0.97		
2011 (half year)	BC = 0.14*BS + 0.33	0.97		

14/03/2007 until 30/06/2011

$$y = 0.14x + 0.80$$

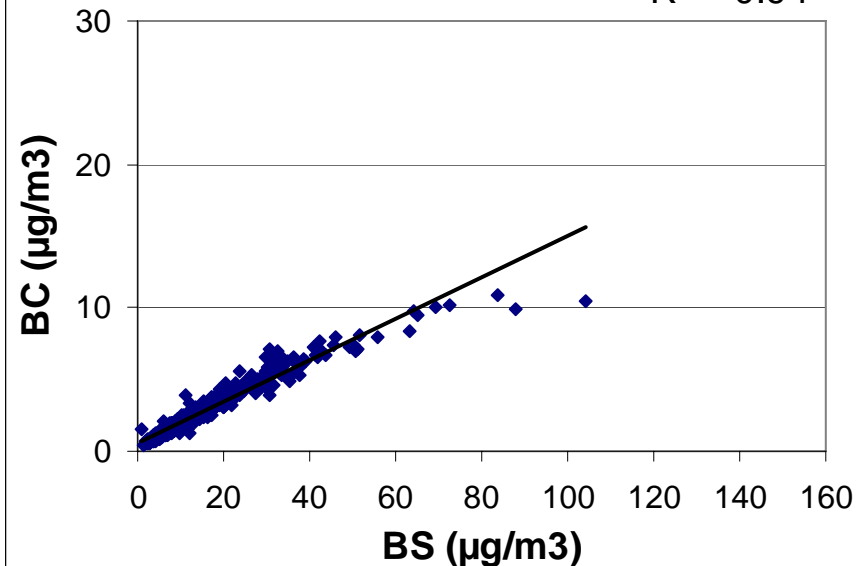
$$R^2 = 0.89$$



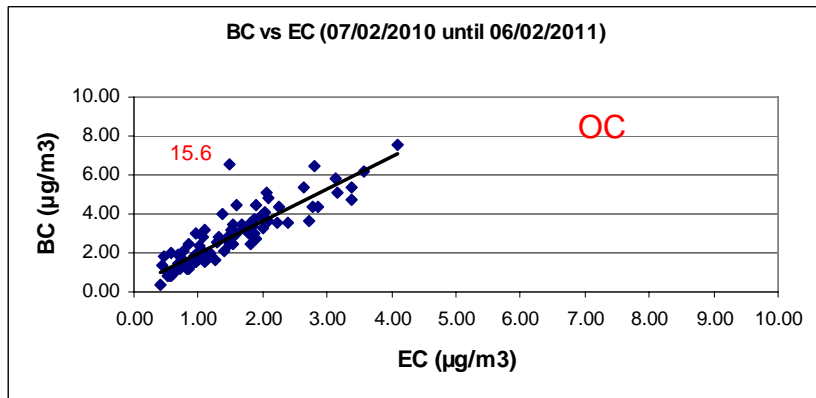
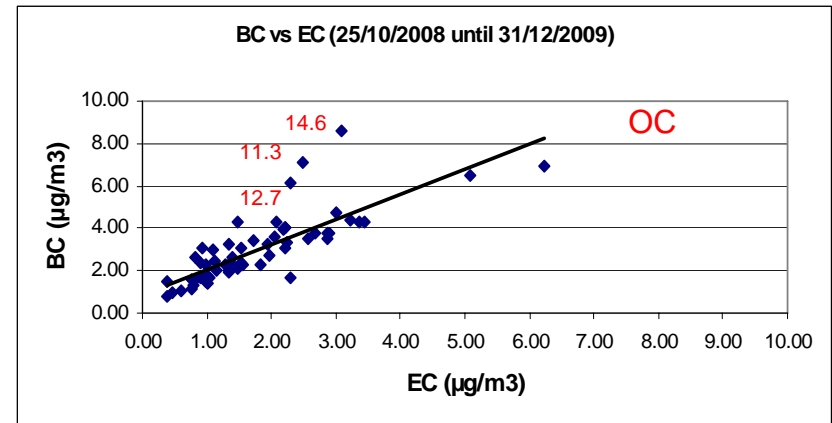
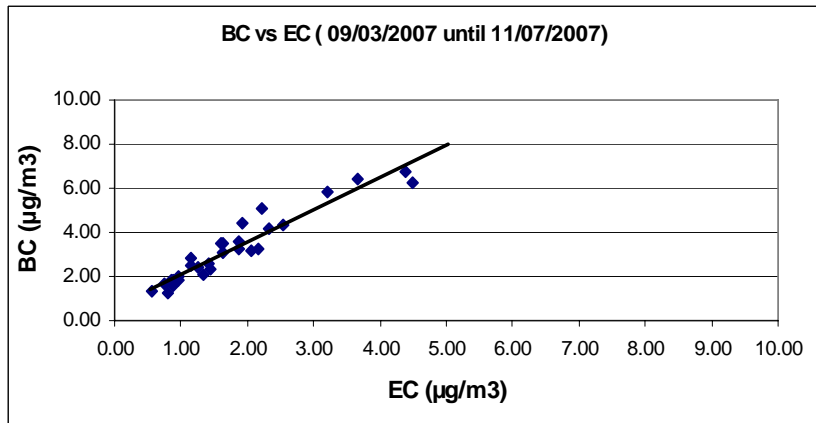
14/03/2007 until 31/12/2009

$$y = 0.14x + 0.52$$

$$R^2 = 0.94$$



Comparison BC (MAAP 5012) vs EC (TOT-NIOSH) at Borgerhout (urban-traffic)



		R^2	BC/EC
2007	$BC = 1.45 * EC + 0.66$	0.91	1.82
2008-2009	$BC = 1.18 * EC + 0.92$	0.64	1.68
2010-2011	$BC = 1.65 * EC + 0.35$	0.78	1.89

- Comparison of black carbon (MAAP 5012) vs black smoke (ETL SX 200)
- Life+ ATMOSYS (VITO, VMM, IRCEL)
 - Modelling and prediction of EC
 - Chemical characterisation
 - in 4 major cities
 - 1 traffic, 1 urban background, 1 major (open) road
 - July 2011 – June 2012
 - Profile on highway:
 - PM10, PM2.5, BC
 - 2012-2013
 - <http://www.life-atmosys.be>

Conclusions

- PM10 smog periods
 - elevated SIA and OM
- OM
 - indication of local sources based on Wdir
- EC
 - indication of traffic combustion
- Wood burning can have quite a large effect on the number of PM10 exceedance days
- Very good correlation between BC and BS
- Good correlation between BC and EC