APPENDIX I

Tables with Results of the Action

Part A) Data of the aerosol data compilation (WG1)

Annex 1: Sites and data providers

Country	Location	Site	Type	lat	long	alt	Contact	
Austria	Wien C	RHV	kerbside	48.20	16.37	185	R. Hitzenberger	Univ. Vienna
	Wien W	Währinger Str.	urban	48.22	16.35	185	H. Puxbaum	TU Vienna
	Graz	Hergottwiesgasse	urban	47.03	15.43	345	H. Puxbaum	TU Vienna
	Streithofen	Michelhausen	rural	48.27	15.93	220	H. Puxbaum	TU Vienna
	Linz	Blumauer Str.	urban	48.30	14.30	263	H. Puxbaum	TU Vienna
Czech Republic	Kosetice	EMEP station	rural	49.60	15.08	534	J. Santroch	CHMI
	Praha	ICPF campus	urban background	50.08	14.43	285	J. Smolik	ICPF, CHMI
Finland	Hyytiälä	SMEAR II	rural	61.85	24.28	180	Pasi Aalto	Univ. Helsinki
	Helsinki V	Vallila	urban traffic	60.19	24.97	3	Juha Pekkanen	National Public Health Institu
Germany	Duisburg	University	urban background	51.43	6.75	31	Thomas Kuhlbusch	IUTA
Hungary	Debrecen		city	47.54	21.68	121	Borbély-Kiss, I.	Hung. Ac. of Sciences
	Budapest C	KFKI campus	urban background	47.5087	19.0278	114	Salma, I.	Eotvos University
	Budapest S	Széna square	downtown	47.5087	19.0278	114	Salma, I.	Eotvos University
	Budapest R	Rákóczi street	downtown	47.5087	19.0278	114	Salma, I.	Eotvos University
	Hortobágy		rural	47.45	20.9333	83	Borbély-Kiss, Ildikó	Hung. Ac. of Sciences
	K-puszta	EMEP station	rural	46.97	19.55	125	Kiss, G.	Pannon University
	K-puszta	EMEP station	rural	46.97	19.55	125	Molnár, A.	Hung. Ac. of Sciences
Italy	Montelibretti	EMEP station	rural	42.10	12.63	48	C. Perrino	CNR - IIA
	Ispra	EMEP station	near city	45.82	8.63	209	JP Putaud	JRC - IES
Netherlands	Amsterdam		urban background	52.30	4.96	2	Harry ten Brink	ECN
	Speulderbos		rural	52.25	5.68	50	Harry ten Brink	ECN
Poland	Krakow	Nowa Huta	urban background	50.07	20.05	219	JP Putaud	JRC IES
Slovenia	Maribor T	Tabor	urban background	46.56	15.66	275	tanja.bolte(a)gov.si	Environmental Agency
	Maribor C	Centre	urban-traffic	46.55	15.68	275	benjamin.lukan(a)zzv-mb.si	Institute of Public Health
	Iskrba	EMEP/GAW st.	rural background	45.56	14.86	520	radojko.jacimovic(a)ijs.si	Josef Stephan Inst.
	Iskrba	EMEP/GAW st.	rural background	45.56	14.86	520	tanja.bolte(a)gov.si	Environmental Agency
Spain	Barcelona H	L'Hospitalet (18)	kerbside	41.37	2.12	12	X. Querol	IJA
	Barcelona S	Sagrera (3)	urban	41.4133	2.19	12	X. Querol	IJA
	Algeciras		urban background*	36.13	-5.54	1	X. Querol	IJA-UHU
	Los Barrios		near city*	36.18	-5.48	47	X. Querol	IJA-UHU
	Llodio		urban background*	43.14	-2.96	130	X. Querol	IJA
	Tarragona		urban background*	41.12	1.25	100	X. Querol	IJA
	Madrid		traffic	40.43	-3.68	667	X. Querol	IJA-CIEMAT
	Huelva		urban background*	37.26	-6.94	10	X. Querol	IJA-UHU
	Canarias	Las Palmas	urban background*	28.13	-15.41	30	X. Querol	IJA
	Monagrega		rural background	40.56	0.28	600	X. Querol	IJA
United Kingdom	London M	Marylbone	kerbside	51.52	-0.16	24	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	London B	Bloomsbury	urban	51.52	-0.13	24	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Harwell		rural	51.57	-1.32	137	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Glasgow		urban centre	55.86	-4.26	59	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Belfast		urban centre	55.00	-5.93	81	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Birmingham		urban centre	52.48	-1.91	134	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Harwell		rural	51.57	-1.32	137	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Manchester		urban centre	53.48	-2.24	89	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	London	Kensington	urban background	51.52	-0.21	24	r.m.harrison(a)bham.ac.uk	Univ. Birmingham
	Port Talbot		industrial	51.58	-3.76	1	r.m.harrison(a)bham.ac.uk	Univ. Birmingham

* with industrial influence

Annex 2.1: concentrations in PM_{10} (µg m^{-3}) in winter (Dec., Jan., Feb.)

PM10	DJF		min. dust	s.salt	SO4	NH4	NO3	unacc.	OM	EC	PM10
rural	Harwell	(UK)	ND	4.05	1.86	ND	2.71	5.45	2.27	0.55	16.88
rural	Speulderbos	(NL)	1.68	5.05	3.69	2.70	5.20	15.51	ND	ND	33.82
urban backgnd	London N	(UK)	ND	5.62	2.18	ND	3.46	10.25	2.35	1.43	25.31
urban centre	Belfast	(UK)	ND	6.92	2.06	ND	2.12	8.88	5.05	2.00	27.02
urban	Duisburg	(DE)	4.08	4.08	5.74	3.65	8.03	8.05	7.58	3.16	40.31
kerbside	London M	(UK)	ND	3.48	3.89	ND	4.86	22.17	5.68	2.97	43.06
kerbside	Helsinki V	(FI)	ND	ND	ND	ND	ND	ND	ND	ND	16.34
rural	Monagrega	(SP)	3.92	1.00	2.31	1.07	4.43	2.73	2.37	0.20	18.02
rural	Montelibretti	(IT)	ND	ND	2.85	ND	4.51	22.96	ND	ND	30.32
near-city	Ispra	(IT)	1.73	1.50	3.34	3.09	8.08	14.86	21.88	3.15	57.63
suburban	Los Barrios	(SP)	3.41	4.45	3.48	1.22	2.65	1.63	ND	ND	21.32
urban backgnd	Canarias	(SP)	13.49	13.71	2.69	0.97	2.55	3.03	ND	ND	52.41
urban backgnd	Llodio	(SP)	7.88	1.94	2.84	1.22	2.57	4.84	ND	ND	34.00
urban backgnd	Tarragona	(SP)	8.79	3.00	3.44	1.69	4.39	5.78	ND	ND	39.14
urban backgnd	Huelva	(SP)	10.16	3.58	3.59	1.41	2.66	5.24	ND	ND	37.26
urban backgnd	Algeciras	(SP)	4.36	4.22	3.00	0.97	3.03	3.30	ND	ND	26.85
urban backgnd	Barcelona S	(SP)	12.10	2.40	4.22	2.67	5.45	4.42	ND	ND	50.63
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	43.08
kerbside	Madrid	(SP)	15.47	1.35	5.52	1.13	2.90	0.65	ND	ND	60.03
kerbside	Barcelona H	(SP)	16.05	2.67	5.53	3.82	8.30	7.27	14.36	1.11	59.10
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	35.18
rural	Streithofen	(AT)	1.51	0.91	3.25	2.80	6.34	2.54	6.02	2.27	25.13
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	17.87	7.41	1.35	26.63
rural	K-Puzsta	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Hortobágy	(HU)	2.77	0.08	8.81	ND	ND	20.28	ND	ND	31.95
urban backgnd	Linz	(AT)	5.67	1.93	7.69	4.16	6.73	10.71	8.39	5.93	49.97
urban backgnd	Graz	(AT)	7.92	1.73	5.09	2.57	4.48	9.90	14.71	6.61	51.84
urban backgnd	Wien W	(AT)	4.98	1.49	4.31	2.72	6.88	4.48	9.12	4.54	37.52
urban backgnd	Praha	(CZ)	1.14	0.96	3.54	1.80	3.01	15.57	ND	ND	26.03
urban backgnd	Debrecen	(HU)	4.17	0.20	6.02	ND	ND	24.50	ND	ND	34.90
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	44.25	ND	6.65	50.89
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Annex 2.2: concentrations in PM_{10} (µg m^{-3}) in spring (March, April, May)

PM10	MAM		min. dust	s.salt	SO4	NH4	NO3	unacc.	OM	EC	PM10
rural	Harwell	(UK)	ND	2.47	2.97	ND	4.07	6.98	2.72	0.71	19.93
rural	Speulderbos	(NL)	2.17	3.70	6.91	4.43	9.12	11.53	ND	ND	37.86
urban backgnd	London N	(UK)	ND	3.82	3.46	ND	4.71	13.77	2.70	0.90	29.35
urban centre	Belfast	(UK)	ND	4.75	2.45	ND	2.72	11.50	3.25	1.27	25.94
urban	Duisburg	(DE)	4.73	4.73	5.33	3.61	8.13	7.58	4.58	2.08	34.93
kerbside	London M	(UK)	ND	5.54	3.38	ND	7.30	21.60	5.90	3.14	46.85
kerbside	Helsinki V	(FI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Monagrega	(SP)	5.85	0.77	3.18	0.82	2.54	2.53	1.83	0.27	16.74
rural	Montelibretti	(IT)	ND	ND	4.22	ND	3.90	22.28	ND	ND	30.40
near-city	Ispra	(IT)	3.04	0.96	6.00	4.04	8.21	13.08	9.57	2.00	50.74
suburban	Los Barrios	(SP)	5.95	3.92	4.38	1.13	2.45	1.84	ND	ND	24.65
urban backgnd	Canarias	(SP)	8.11	13.83	2.61	1.12	1.69	5.39	ND	ND	41.50
urban backgnd	Llodio	(SP)	6.46	4.68	4.42	1.47	1.55	3.30	ND	ND	30.23
urban backgnd	Tarragona	(SP)	11.84	4.74	4.80	1.52	4.16	3.28	ND	ND	40.29
urban backgnd	Huelva	(SP)	8.59	3.31	3.04	0.71	1.16	7.59	ND	ND	31.17
urban backgnd	Algeciras	(SP)	7.83	6.75	3.92	1.34	2.91	15.21	ND	ND	43.23
urban backgnd	Barcelona S	(SP)	20.62	4.73	4.76	2.30	4.12	2.08	ND	ND	50.86
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	31.43
kerbside	Madrid	(SP)	12.28	1.02	3.21	0.94	1.85	3.16	ND	ND	40.86
kerbside	Barcelona H	(SP)	12.99	4.47	6.82	2.77	6.28	5.79	9.21	0.83	47.01
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	34.21
rural	Streithofen	(AT)	2.01	0.40	3.53	1.98	3.05	5.13	5.14	1.52	22.32
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	21.62	6.77	1.03	29.41
rural	K-Puzsta	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Hortobágy	(HU)	3.13	0.05	5.23	ND	ND	13.41	ND	ND	21.82
urban backgnd	Linz	(AT)	4.32	0.72	4.21	2.28	3.57	5.25	4.29	3.15	27.04
urban backgnd	Graz	(AT)	5.27	0.52	4.35	1.83	2.06	4.89	5.43	3.77	27.41
urban backgnd	Wien W	(AT)	4.16	0.50	4.22	1.92	2.91	4.85	7.26	2.98	28.13
urban backgnd	Praha	(CZ)	0.78	0.87	3.74	2.21	4.23	15.93	ND	ND	27.77
urban backgnd	Debrecen	(HU)	6.94	0.09	4.55	ND	ND	19.81	ND	ND	31.39
urban backgnd	Budapest C	(HU)	4.36	0.64	8.49	ND	ND	34.16	ND	3.32	50.97
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	29.13	ND	3.29	32.42
kerbside	Budapest S	(HU)	4.76	0.47	3.09	ND	ND	23.07	ND	3.74	26.81
kerbside	Budapest R	(HU)	12.35	1.64	5.09	ND	ND	50.30	15.87	4.44	54.74

Annex 2.3: concentrations in PM_{10} (µg m^{-3}) in summer (June, July, Aug.)

PM10	JJA		min. dust	s.salt	SO4	NH4	NO3	unacc.	OM	EC	PM10
rural	Harwell	(UK)	ND	0.75	2.27	ND	2.23	9.47	3.64	0.84	19.19
rural	Speulderbos	(NL)	1.49	2.42	5.28	3.12	4.17	20.23	ND	ND	36.71
urban backgnd	London N	(UK)	ND	0.89	2.48	ND	3.41	14.97	4.00	0.84	26.59
urban centre	Belfast	(UK)	ND	2.19	1.49	ND	1.70	8.53	3.09	0.78	17.78
urban	Duisburg	(DE)	3.85	3.85	6.23	1.89	3.15	4.24	5.60	2.43	26.38
kerbside	London M	(UK)	ND	1.45	3.60	ND	4.66	26.90	7.45	4.25	48.31
kerbside	Helsinki V	(FI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Monagrega	(SP)	7.35	1.05	5.58	1.76	1.03	4.15	2.94	0.32	27.42
rural	Montelibretti	(IT)	ND	ND	6.37	ND	2.57	21.86	ND	ND	30.80
near-city	Ispra	(IT)	1.14	0.32	3.56	1.38	0.34	5.02	5.24	1.26	19.48
suburban	Los Barrios	(SP)	11.24	5.05	7.10	1.73	2.39	6.12	ND	ND	38.79
urban backgnd	Canarias	(SP)	7.37	13.55	3.08	1.00	1.39	10.36	ND	ND	44.71
urban backgnd	Llodio	(SP)	7.89	5.80	9.50	2.41	1.81	1.67	ND	ND	37.66
urban backgnd	Tarragona	(SP)	7.46	4.95	5.89	1.32	2.43	3.35	ND	ND	33.79
urban backgnd	Huelva	(SP)	25.42	5.33	7.87	2.09	1.82	-5.40	ND	ND	43.56
urban backgnd	Algeciras	(SP)	11.96	5.05	7.36	1.97	3.89	8.60	ND	ND	45.92
urban backgnd	Barcelona S	(SP)	12.72	4.78	6.44	1.76	2.56	2.70	ND	ND	39.99
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	24.41
kerbside	Madrid	(SP)	18.88	1.15	5.15	1.33	1.13	3.23	ND	ND	47.67
kerbside	Barcelona H	(SP)	11.17	3.84	8.52	2.02	3.42	4.90	7.60	0.71	39.84
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	25.09
rural	Streithofen	(AT)	0.48	0.15	3.66	2.09	0.45	5.30	5.98	1.56	19.57
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	13.81	7.62	1.19	22.62
rural	K-Puzsta	(HU)	3.56	4.09	2.96	1.73	2.58	13.00	7.87	ND	35.79
rural	Hortobágy	(HU)	4.47	0.05	6.33	ND	ND	16.24	ND	ND	27.09
urban backgnd	Linz	(AT)	2.76	0.57	4.15	1.54	1.22	5.62	4.47	2.67	22.39
urban backgnd	Graz	(AT)	3.47	0.35	3.92	1.44	0.58	4.06	4.48	2.69	20.46
urban backgnd	Wien W	(AT)	1.74	0.29	4.23	1.96	0.63	5.32	6.22	2.77	22.82
urban backgnd	Praha	(CZ)	1.17	0.27	3.40	1.28	1.18	11.91	ND	ND	19.21
urban backgnd	Debrecen	(HU)	5.04	0.04	4.18	ND	ND	17.49	ND	ND	26.74
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	28.72	ND	2.54	31.26
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Annex 2.4: concentrations in PM_{10} (µg m^{-3}) in autumn (Sep., Oct., Nov.)

PM10	SON		min. dust	s.salt	SO4	NH4	NO3	unacc.	OM	EC	PM10
rural	Harwell	(UK)	ND	2.43	2.42	ND	3.24	6.97	2.53	0.70	18.30
rural	Speulderbos	(NL)	1.31	2.16	4.64	3.43	6.69	22.98	ND	ND	41.21
urban backgnd	London N	(UK)	ND	2.56	2.52	ND	3.54	12.18	4.70	1.31	26.81
urban centre	Belfast	(UK)	ND	3.59	1.57	ND	1.82	13.19	2.08	1.22	23.47
urban	Duisburg	(DE)	3.30	3.30	3.70	1.89	4.74	7.84	4.68	2.36	28.48
kerbside	London M	(UK)	ND	1.09	3.46	ND	4.93	26.71	7.46	4.12	47.79
kerbside	Helsinki V	(FI)	ND	ND	ND	ND	ND	ND	ND	ND	17.57
rural	Monagrega	(SP)	4.82	1.06	3.63	1.32	2.49	3.02	2.32	0.27	19.95
rural	Montelibretti	(IT)	ND	ND	2.82	ND	2.68	15.75	ND	ND	21.26
near-city	Ispra	(IT)	0.52	0.53	3.05	2.21	4.02	7.94	13.13	1.72	30.80
suburban	Los Barrios	(SP)	4.81	4.12	3.94	1.03	2.04	2.02	ND	ND	22.29
urban backgnd	Canarias	(SP)	9.47	11.85	2.42	0.75	1.59	1.25	ND	ND	37.65
urban backgnd	Llodio	(SP)	8.62	3.26	4.14	1.09	3.67	16.44	ND	ND	47.18
urban backgnd	Tarragona	(SP)	10.63	3.59	4.65	0.98	3.57	2.46	ND	ND	36.55
urban backgnd	Huelva	(SP)	9.49	3.50	4.02	1.15	1.79	8.68	ND	ND	35.48
urban backgnd	Algeciras	(SP)	5.98	6.42	4.11	1.35	3.73	7.77	ND	ND	36.63
urban backgnd	Barcelona S	(SP)	14.30	3.88	4.34	1.55	3.55	3.44	ND	ND	44.80
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	29.26
kerbside	Madrid	(SP)	15.83	1.14	5.54	1.56	2.58	0.99	ND	ND	46.76
kerbside	Barcelona H	(SP)	13.70	3.08	6.25	2.08	4.88	6.82	14.50	0.88	55.39
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	30.20
rural	Streithofen	(AT)	1.19	0.48	5.13	3.41	6.10	2.20	6.85	2.47	27.49
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	12.91	4.67	0.82	18.40
rural	K-Puzsta	(HU)	0.00	2.60	0.31	0.46	1.00	0.90	8.21	ND	13.47
rural	Hortobágy	(HU)	3.84	0.08	6.30	ND	ND	17.60	ND	ND	27.82
urban backgnd	Linz	(AT)	3.96	0.86	4.41	2.11	3.63	11.44	5.48	4.27	35.39
urban backgnd	Graz	(AT)	5.13	0.68	3.60	1.40	1.80	6.38	7.02	5.63	30.87
urban backgnd	Wien W	(AT)	3.13	0.73	5.52	3.33	5.56	1.92	9.96	3.71	33.26
urban backgnd	Praha	(CZ)	1.40	0.61	3.81	2.17	4.01	18.46	ND	ND	30.47
urban backgnd	Debrecen	(HU)	5.13	0.07	4.43	ND	ND	21.23	ND	ND	30.86
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	25.13	ND	3.96	29.09
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Annex 3.1: concentrations in $PM_{2.5}$ (µg m^{-3}) in winter (Dec., Jan., Feb.)

PM2.5	DJF		min. dust	sea salt	nssSO4	NH4	NO3	unacc.	OM	EC	PM2.5
rural	Harwell	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	9.97
rural	Speulderbos	(NL)	0.39	1.13	3.18	2.15	3.53	ND	ND	ND	ND
urban backgnd	London N	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban centre	Belfast	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban	Duisburg	(DE)	1.69	0.87	5.33	3.62	6.92	7.34	5.92	3.28	34.97
kerbside	London M	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	18.14
kerbside	Helsinki V	(FI)	0.17	0.52	4.39	ND	ND	6.83	ND	ND	11.91
rural	Monagrega	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Montelibretti	(IT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
near-city	Ispra	(IT)	1.62	1.01	4.69	3.34	7.60	4.09	31.16	4.04	49.37
suburban	Los Barrios	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Canarias	(SP)	3.68	2.27	2.31	0.79	0.67	1.89	ND	ND	26.10
urban backgnd	Llodio	(SP)	2.14	0.89	2.56	1.16	1.00	1.88	ND	ND	22.63
urban backgnd	Tarragona	(SP)	2.40	0.90	3.06	1.45	2.83	0.18	ND	ND	22.45
urban backgnd	Huelva	(SP)	2.50	1.28	2.97	1.13	1.39	3.11	ND	ND	22.95
urban backgnd	Algeciras	(SP)	1.35	1.06	2.66	1.26	1.12	4.82	ND	ND	18.41
urban backgnd	Barcelona S	(SP)	4.89	0.73	3.16	1.90	3.26	0.00	ND	ND	30.27
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Madrid	(SP)	8.03	0.75	4.24	1.26	1.77	3.94	ND	ND	50.75
kerbside	Barcelona H	(SP)	5.70	0.92	4.50	3.85	6.83	2.48	ND	ND	42.27
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Streithofen	(AT)	0.24	0.39	2.45	2.26	4.44	4.08	4.44	2.03	20.32
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	K-Puzsta	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Hortobágy	(HU)	1.21	0.07	7.30	ND	ND	14.90	ND	ND	23.48
urban backgnd	Linz	(AT)	0.64	0.42	6.07	3.85	5.90	6.37	5.61	5.70	34.56
urban backgnd	Graz	(AT)	0.81	0.33	8.15	4.39	5.84	0.41	10.17	6.44	36.54
urban backgnd	Wien W	(AT)	0.87	0.53	3.74	2.80	5.48	3.00	7.25	4.92	28.59
urban backgnd	Praha	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Debrecen	(HU)	1.17	0.05	4.72	ND	ND	17.65	ND	ND	23.60
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Annex 3.2: concentrations in $PM_{2.5}$ (µg m^{-3}) in spring (March, April, May)

PM2.5	MAM		min. dust	sea salt	nssSO4	NH4	NO3	unacc.	OM	EC	PM2.5
rural	Harwell	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	11.82
rural	Speulderbos	(NL)	0.52	1.17	6.02	3.92	7.07	ND	ND	ND	ND
urban backgnd	London N	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban centre	Belfast	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban	Duisburg	(DE)	2.08	0.68	4.64	2.89	5.18	5.30	4.31	2.28	27.36
kerbside	London M	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	19.97
kerbside	Helsinki V	(FI)	0.29	0.17	5.14	ND	ND	8.93	ND	ND	14.52
rural	Monagrega	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Montelibretti	(IT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
near-city	Ispra	(IT)	0.43	0.03	5.27	3.53	6.37	11.56	8.69	1.55	37.45
suburban	Los Barrios	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Canarias	(SP)	2.75	2.35	2.08	0.90	0.50	1.13	ND	ND	17.46
urban backgnd	Llodio	(SP)	2.91	1.03	4.39	1.64	0.93	4.48	ND	ND	25.20
urban backgnd	Tarragona	(SP)	2.31	1.28	3.46	2.05	2.22	0.00	ND	ND	22.38
urban backgnd	Huelva	(SP)	2.20	0.69	2.61	0.87	0.39	5.17	ND	ND	18.29
urban backgnd	Algeciras	(SP)	5.08	1.60	3.75	1.49	1.11	13.40	ND	ND	31.64
urban backgnd	Barcelona S	(SP)	5.01	0.54	4.81	2.65	2.46	3.24	ND	ND	32.50
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Madrid	(SP)	4.15	0.36	2.95	1.15	1.14	3.30	ND	ND	30.55
kerbside	Barcelona H	(SP)	4.24	0.87	5.76	3.40	4.59	0.00	ND	ND	28.85
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Streithofen	(AT)	0.27	0.25	3.12	1.80	1.90	2.77	4.35	1.60	16.08
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	K-Puzsta	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Hortobágy	(HU)	1.13	0.04	4.85	ND	ND	8.66	ND	ND	14.67
urban backgnd	Linz	(AT)	0.45	0.18	2.97	2.01	3.15	2.69	2.87	3.10	17.43
urban backgnd	Graz	(AT)	0.78	0.28	3.82	1.93	1.46	10.93	3.32	3.59	17.84
urban backgnd	Wien W	(AT)	0.53	0.25	3.82	1.85	1.98	2.12	5.10	3.12	18.76
urban backgnd	Praha	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Debrecen	(HU)	1.75	0.04	3.91	ND	ND	10.66	ND	ND	16.36
urban backgnd	Budapest C	(HU)	0.72	0.29	9.51	ND	ND	10.68	ND	3.64	21.19
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest S	(HU)	0.44	0.08	2.27	ND	ND	7.16	ND	ND	9.95
kerbside	Budapest R	(HU)	1.41	0.37	3.43	1.06	ND	0.14	10.75	4.87	20.97

Annex 3.3: concentrations in $PM_{2.5}$ (µg m^{-3}) in summer (Jun., Jul., Aug.)

PM2.5	JJA		min. dust	sea salt	nssSO4	NH4	NO3	unacc.	OM	EC	PM2.5
rural	Harwell	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	10.19
rural	Speulderbos	(NL)	0.31	0.64	5.16	3.06	2.97	ND	ND	ND	ND
urban backgnd	London N	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban centre	Belfast	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban	Duisburg	(DE)	1.22	0.32	5.35	1.67	1.76	1.39	4.33	2.22	18.25
kerbside	London M	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	20.22
kerbside	Helsinki V	(FI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Monagrega	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Montelibretti	(IT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
near-city	Ispra	(IT)	0.22	0.18	3.90	1.59	0.22	5.38	5.16	1.14	17.79
suburban	Los Barrios	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Canarias	(SP)	2.28	2.94	2.05	0.84	0.43	0.00	ND	ND	17.47
urban backgnd	Llodio	(SP)	2.33	3.42	7.28	2.32	0.39	1.91	ND	ND	25.97
urban backgnd	Tarragona	(SP)	2.24	1.11	5.53	2.01	0.48	4.51	ND	ND	23.68
urban backgnd	Huelva	(SP)	3.47	1.21	4.60	1.41	0.32	4.34	ND	ND	21.72
urban backgnd	Algeciras	(SP)	3.68	1.46	5.75	1.90	0.82	7.51	ND	ND	27.47
urban backgnd	Barcelona S	(SP)	3.30	1.00	5.45	1.82	0.50	0.03	ND	ND	22.87
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Madrid	(SP)	8.80	0.60	5.76	2.03	0.86	3.27	ND	ND	37.88
kerbside	Barcelona H	(SP)	2.69	0.70	7.06	2.59	1.03	1.44	ND	ND	24.90
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Streithofen	(AT)	0.23	0.29	3.34	1.39	0.39	2.38	3.84	1.36	13.22
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	K-Puzsta	(HU)	1.98	0.73	3.52	1.98	ND	6.69	6.55	ND	21.45
rural	Hortobágy	(HU)	1.12	0.03	5.70	ND	ND	8.75	ND	ND	15.60
urban backgnd	Linz	(AT)	0.25	0.25	3.25	1.68	0.87	2.40	2.55	2.62	13.85
urban backgnd	Graz	(AT)	0.47	0.15	3.28	1.75	0.37	2.05	2.76	2.77	13.58
urban backgnd	Wien W	(AT)	0.30	0.19	3.78	1.51	0.32	2.57	3.89	2.68	15.23
urban backgnd	Praha	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Debrecen	(HU)	1.19	0.03	3.70	ND	ND	9.30	ND	ND	14.23
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Annex 3.4: concentrations in $PM_{2.5}$ (µg m^{-3}) in autumn (Sep., Oct., Nov.)

PM2.5	SON		min. dust	sea salt	nssSO4	NH4	NO3	unacc.	OM	EC	PM2.5
rural	Harwell	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	10.16
rural	Speulderbos	(NL)	0.35	0.60	3.88	3.05	5.35	ND	ND	ND	ND
urban backgnd	London N	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban centre	Belfast	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban	Duisburg	(DE)	1.12	0.56	3.18	1.63	3.31	5.23	3.67	2.35	21.06
kerbside	London M	(UK)	ND	ND	ND	ND	ND	ND	ND	ND	20.92
kerbside	Helsinki V	(FI)	0.21	0.17	4.17	ND	ND	7.60	ND	ND	12.14
rural	Monagrega	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Montelibretti	(IT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
near-city	Ispra	(IT)	0.12	0.37	2.79	1.93	2.87	4.72	9.98	1.36	24.14
suburban	Los Barrios	(SP)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Canarias	(SP)	2.79	1.81	2.38	0.66	0.37	2.04	ND	ND	21.94
urban backgnd	Llodio	(SP)	3.18	3.14	4.80	1.14	0.61	4.19	ND	ND	28.31
urban backgnd	Tarragona	(SP)	2.27	1.37	3.98	1.25	1.55	3.29	ND	ND	23.87
urban backgnd	Huelva	(SP)	2.58	1.26	2.77	0.92	0.84	4.09	ND	ND	20.09
urban backgnd	Algeciras	(SP)	1.44	1.80	3.76	1.47	1.43	6.91	ND	ND	23.67
urban backgnd	Barcelona S	(SP)	3.86	1.02	3.74	1.47	1.57	0.72	ND	ND	27.35
urban backgnd	Maribor T	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Madrid	(SP)	6.84	0.52	5.35	2.21	2.06	0.00	ND	ND	38.33
kerbside	Barcelona H	(SP)	4.51	0.88	5.12	2.51	3.17	0.00	ND	ND	37.01
kerbside	Maribor C	(SI)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	Streithofen	(AT)	0.17	0.24	3.90	2.45	4.24	1.27	5.53	2.64	20.43
rural	Kosetice	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
rural	K-Puzsta	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	9.26
rural	Hortobágy	(HU)	1.15	0.05	5.50	ND	ND	11.59	ND	ND	18.30
urban backgnd	Linz	(AT)	0.60	0.25	3.19	2.04	3.26	5.55	2.86	4.18	21.93
urban backgnd	Graz	(AT)	1.02	0.44	2.92	1.52	1.10	11.47	4.85	4.95	21.27
urban backgnd	Wien W	(AT)	0.28	0.25	4.90	2.61	3.24	2.59	6.44	4.22	24.53
urban backgnd	Praha	(CZ)	ND	ND	ND	ND	ND	ND	ND	ND	ND
urban backgnd	Debrecen	(HU)	1.28	0.04	3.77	ND	ND	12.76	ND	ND	17.84
urban backgnd	Budapest C	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Wien C	(AT)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest S	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND
kerbside	Budapest R	(HU)	ND	ND	ND	ND	ND	ND	ND	ND	ND

Part B) Temporal trends of black carbon derived from black smoke data

The data in this part of the appendix were collated by Hannes Subera, University of Vienna. The plots are listed by country (in alphabetical order of the international country code).

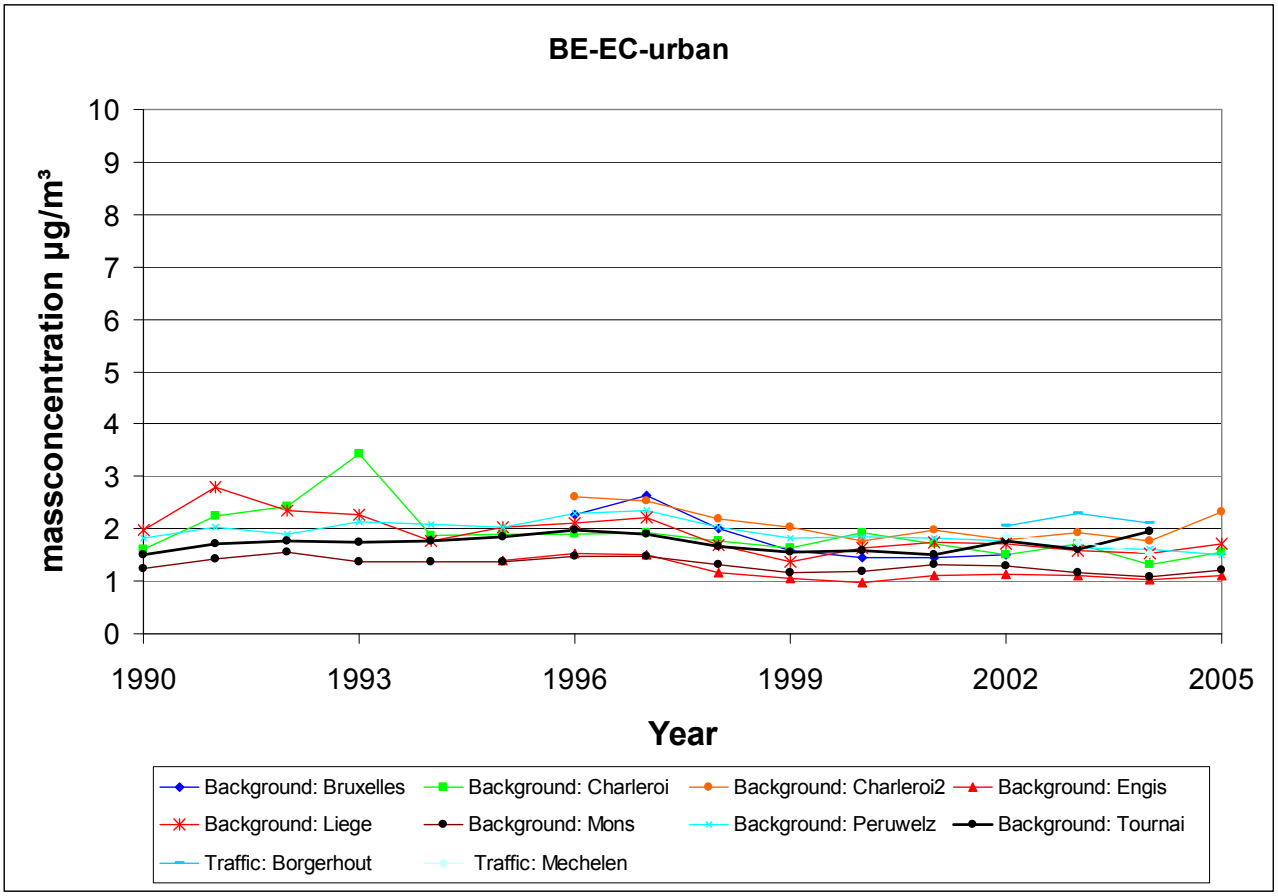
Data were obtained from / provided by:

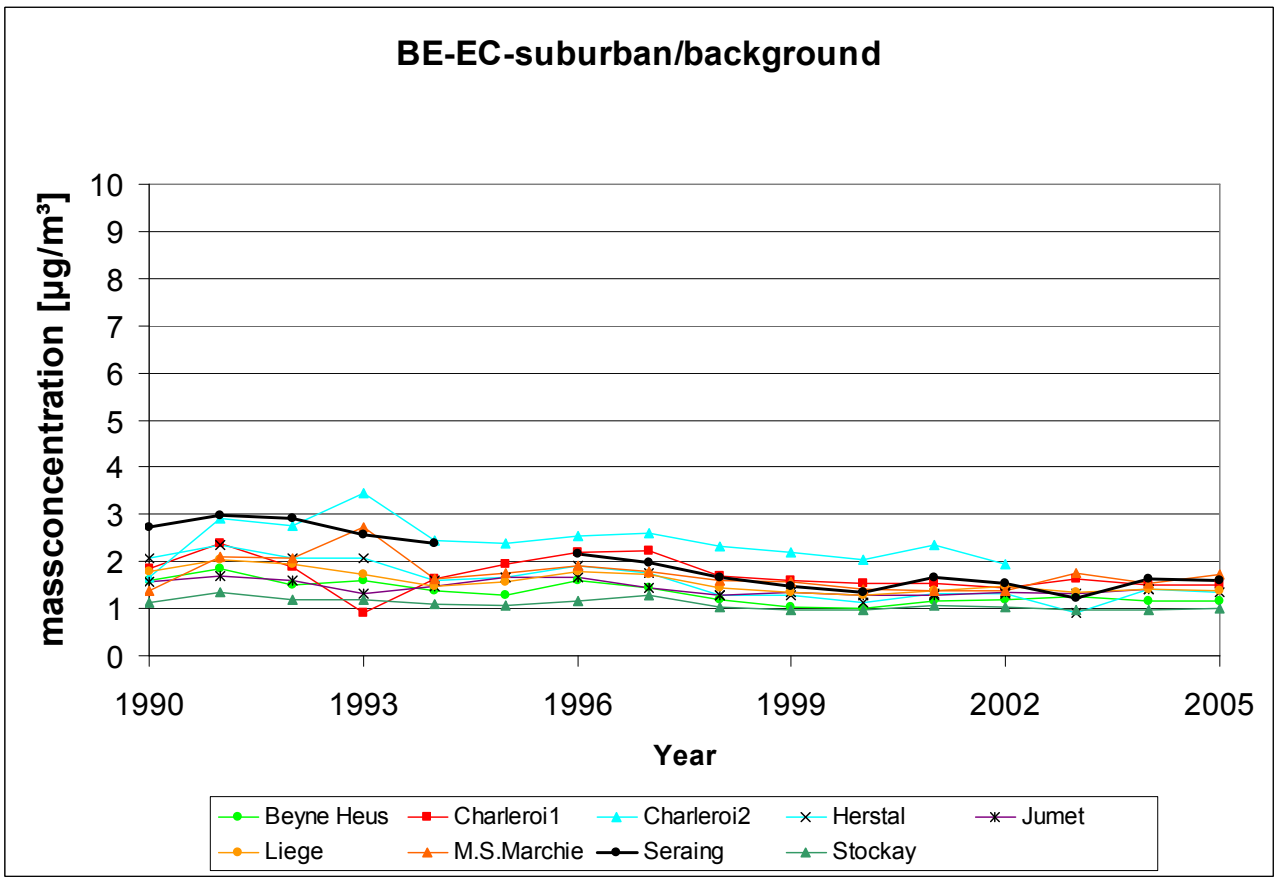
BE Belgium	AirNet*
DK Denmark	AirNet* and Environmental Protection Agency for the City of Copenhagen, http://www.miljoe.kk.dk/94d9a7a1-6f48-4c72-9c51-f3bc4f5bec4d.W5Doc
E Spain	AirNet*
F France	AirNet*
FI Finland	Juha Pekkanen, Environmental Epidemiology Unit, National Public Health Institute (KTL), Finland
GB United Kingdom	http://www.airquality.co.uk/archive/data_and_statistics.php
GR Greece	AirNet*
IR Ireland	AirNet*
MK Macedonia	AirNet*
NL Netherlands	AirNet* and Flemming Cassee, RIVM, Netherlands
PL Poland	AirNet*
PT Portugal	AirNet*
S Sweden	AirNet*
SI Slovenia	Janja Tursic and Anton Planinsek, Environmental Agency of the Republic of Slovenia

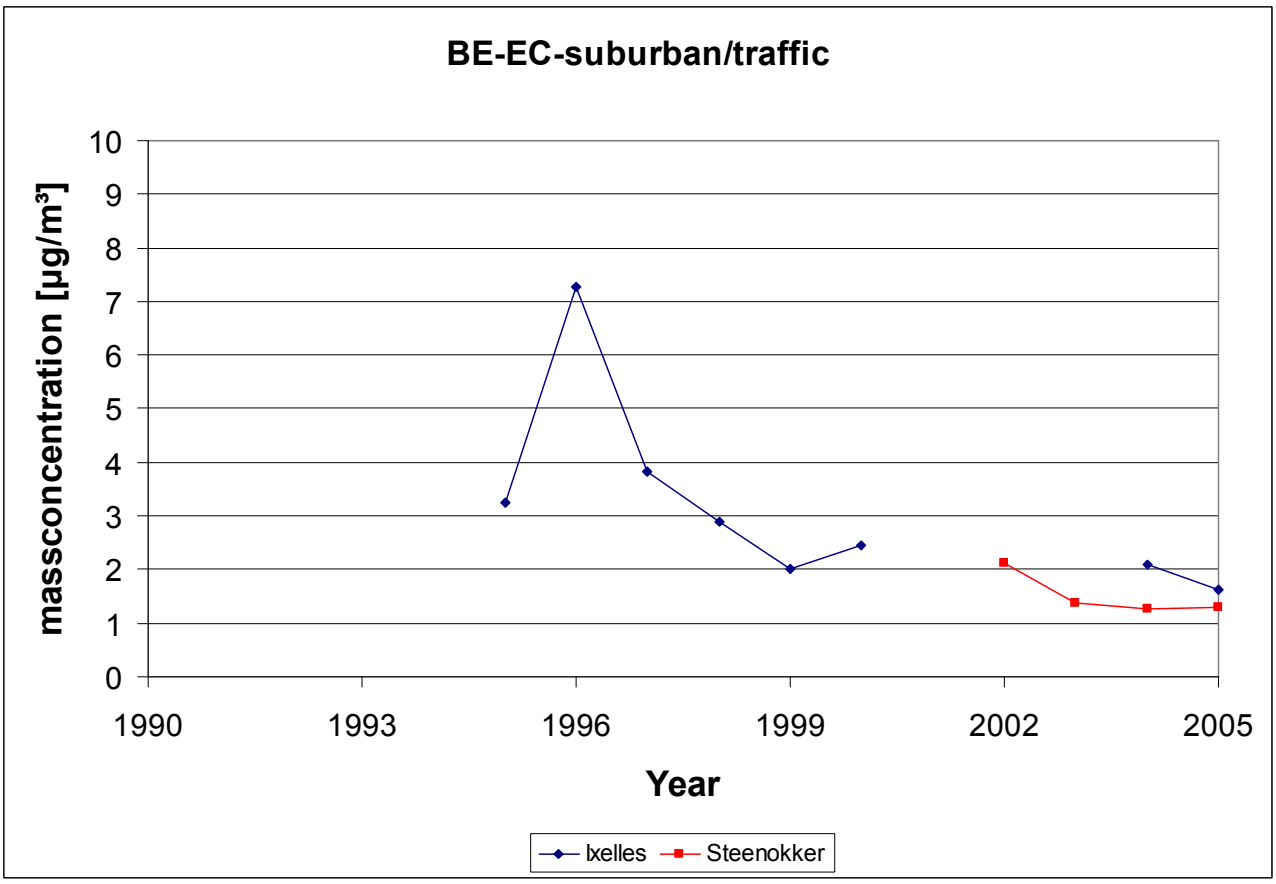
*AirNet: http://dataservice.eea.europa.eu/dataservice/metadetails.asp?id=1029, (© EAA Copenhagen)

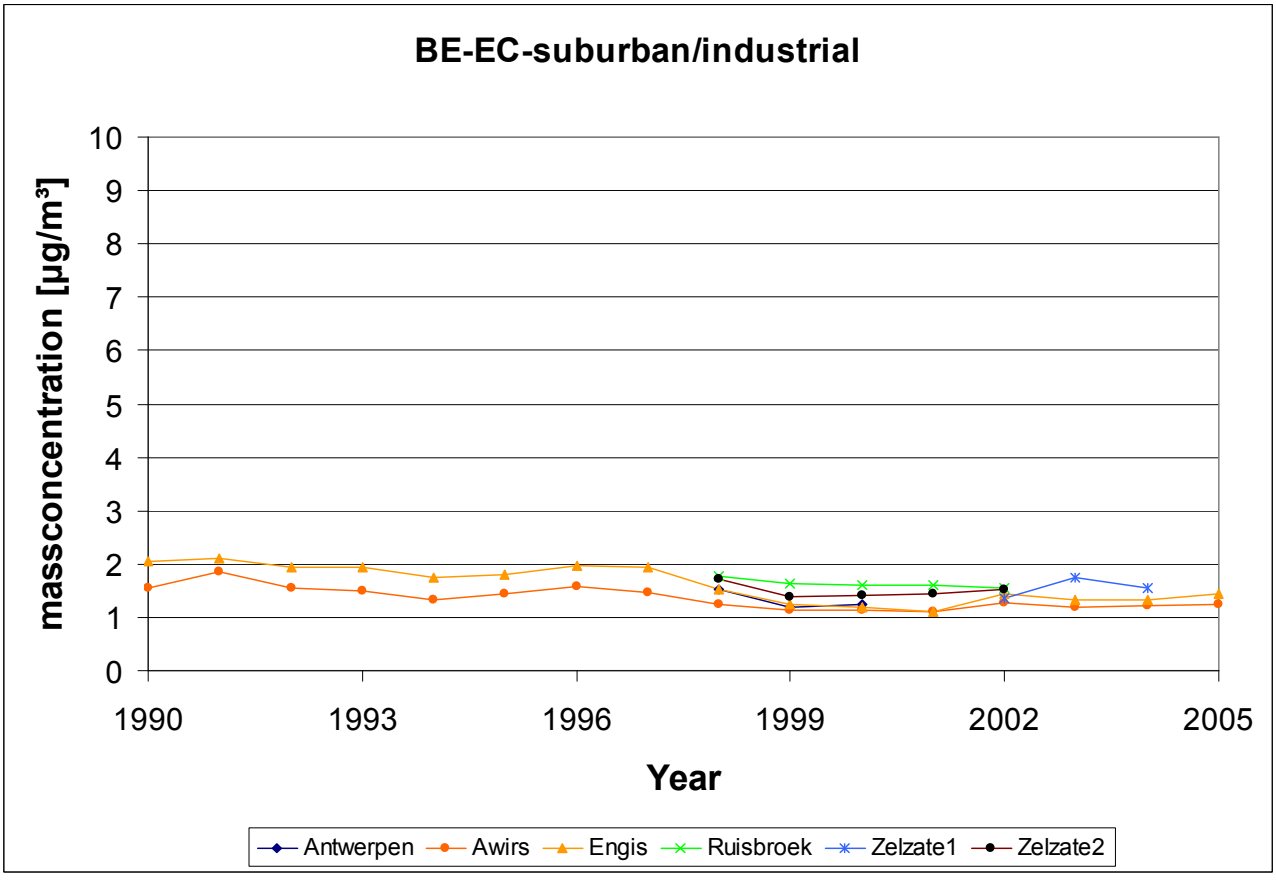
The data were obtained from measured Black Smoke (BS) data. They are given in terms of Elemental Carbon (EC), because the conversion by Schaap and van der Gon (2007, see reference in report) compared BS and EC, not BC.

Belgium

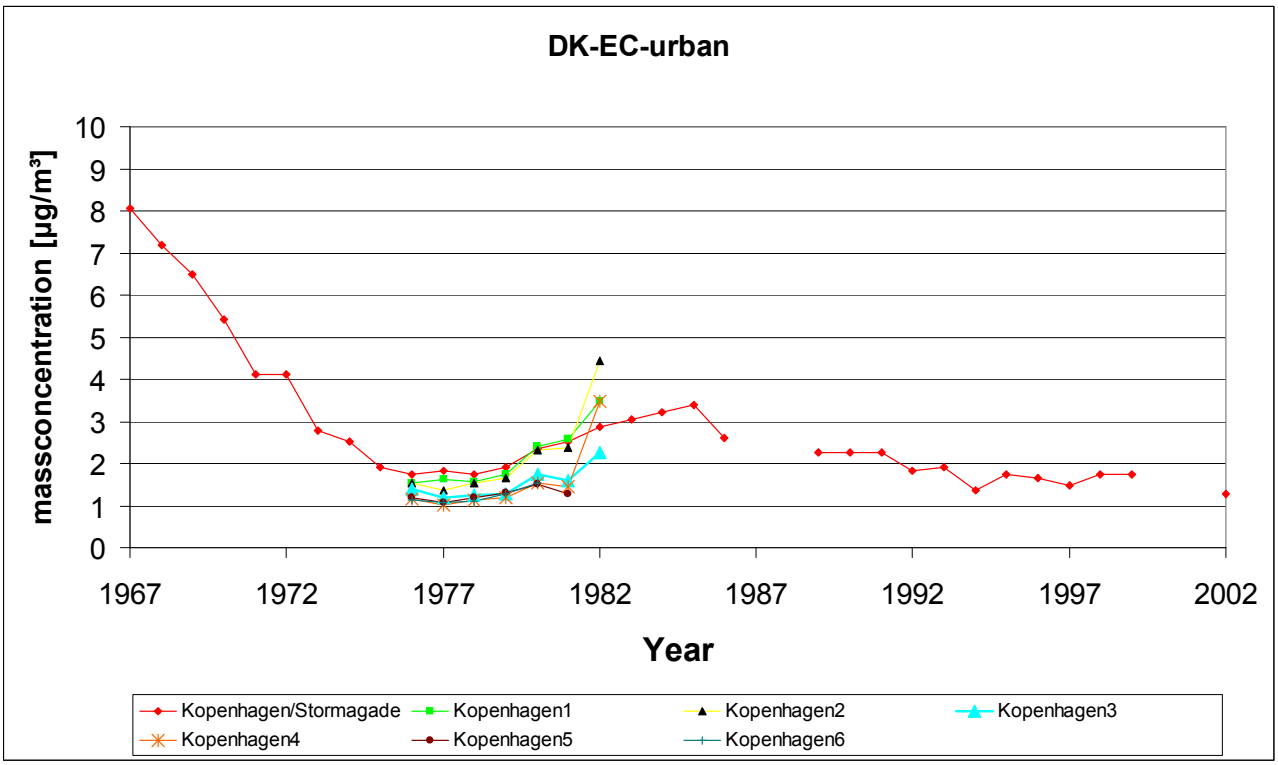

BE-EC-urban
massconcentration µg/m³
10
9
8
7
6
5
4
3
2
1
0
1990
1993
1996
1999
2002
2005
Year
Background: Bruxelles
Background: Charleroi
Background: Charleroi2
Background: Engis
Background: Liege
Background: Mons
Background: Peruwelz
Background: Tournai
Traffic: Borgerhout
Traffic: Mechelen

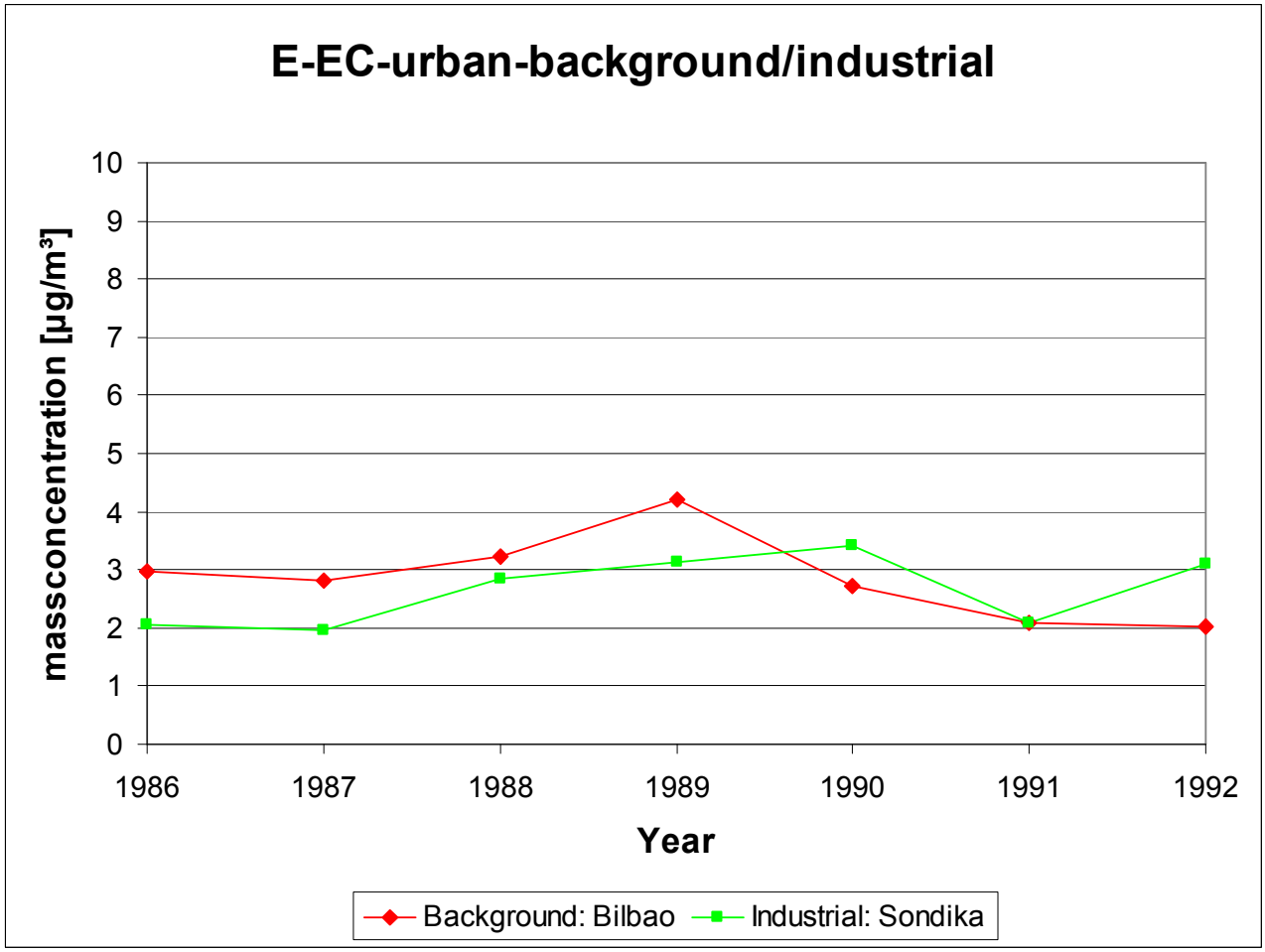

BE-EC-suburban/background
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1990
1993
1996
1999
2002
2005
Year
Beyne Heus
Charleroi1
Charleroi2
Herstal
Jumet
Liege
M.S.Marchie
Seraing
Stockay


BE-EC-suburban/traffic
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1990
1993
1996
1999
2002
2005
Year
Ixelles
Steenokker

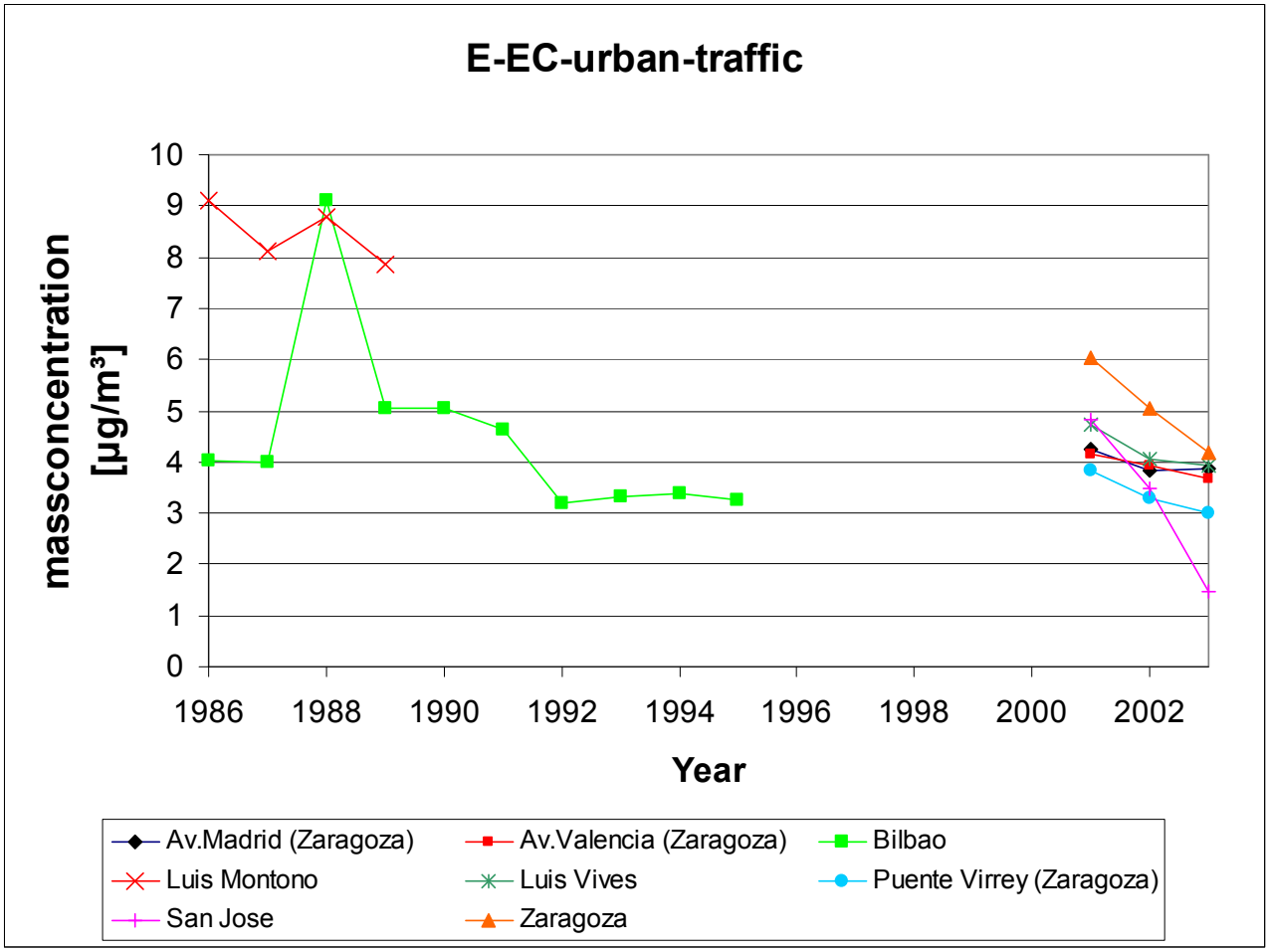

BE-EC-suburban/industrial
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1990
1993
1996
1999
2002
2005
Year
Antwerpen
Awirs
Engis
Ruisbroek
Zelzate1
Zelzate2

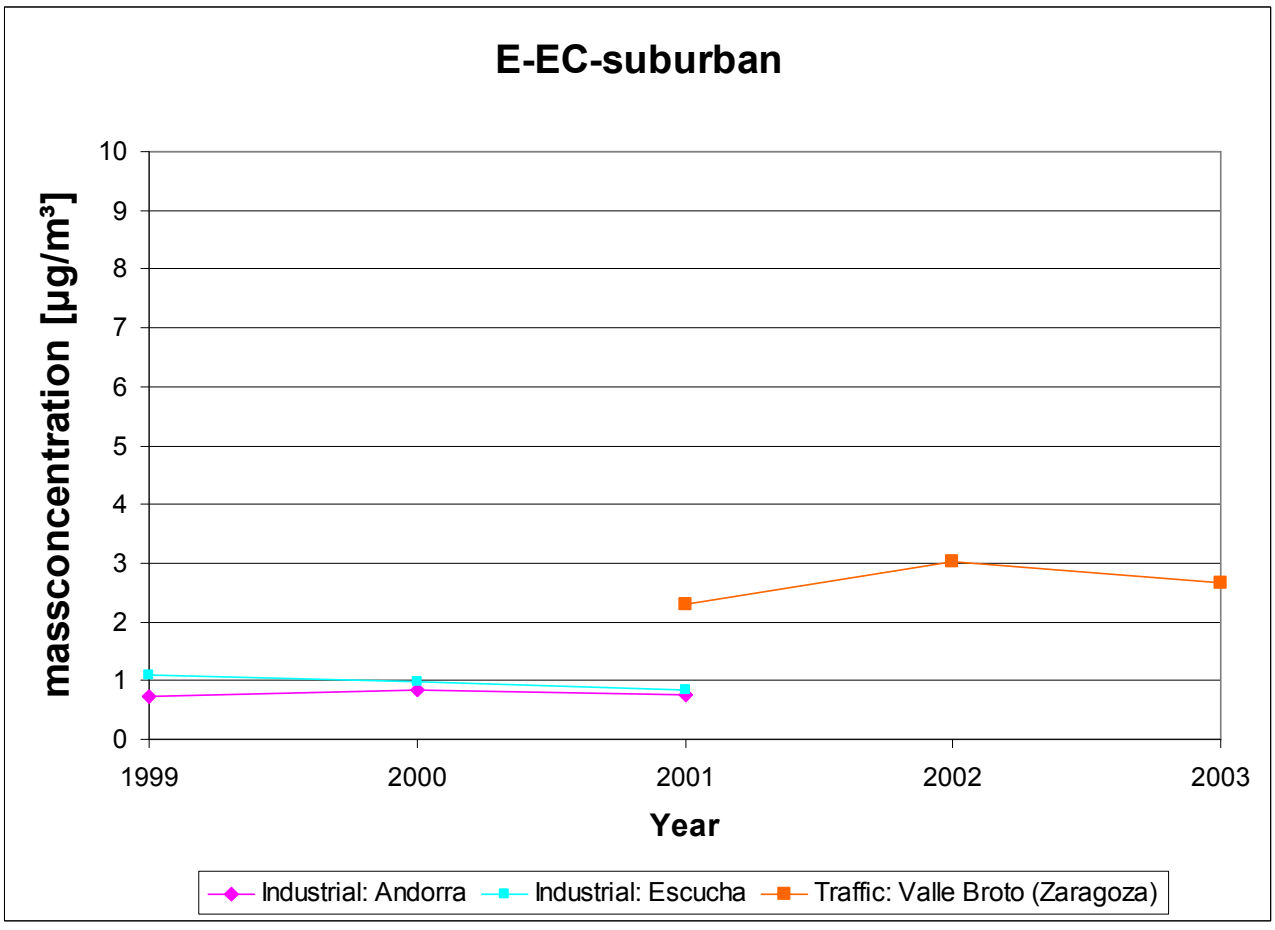
Denmark

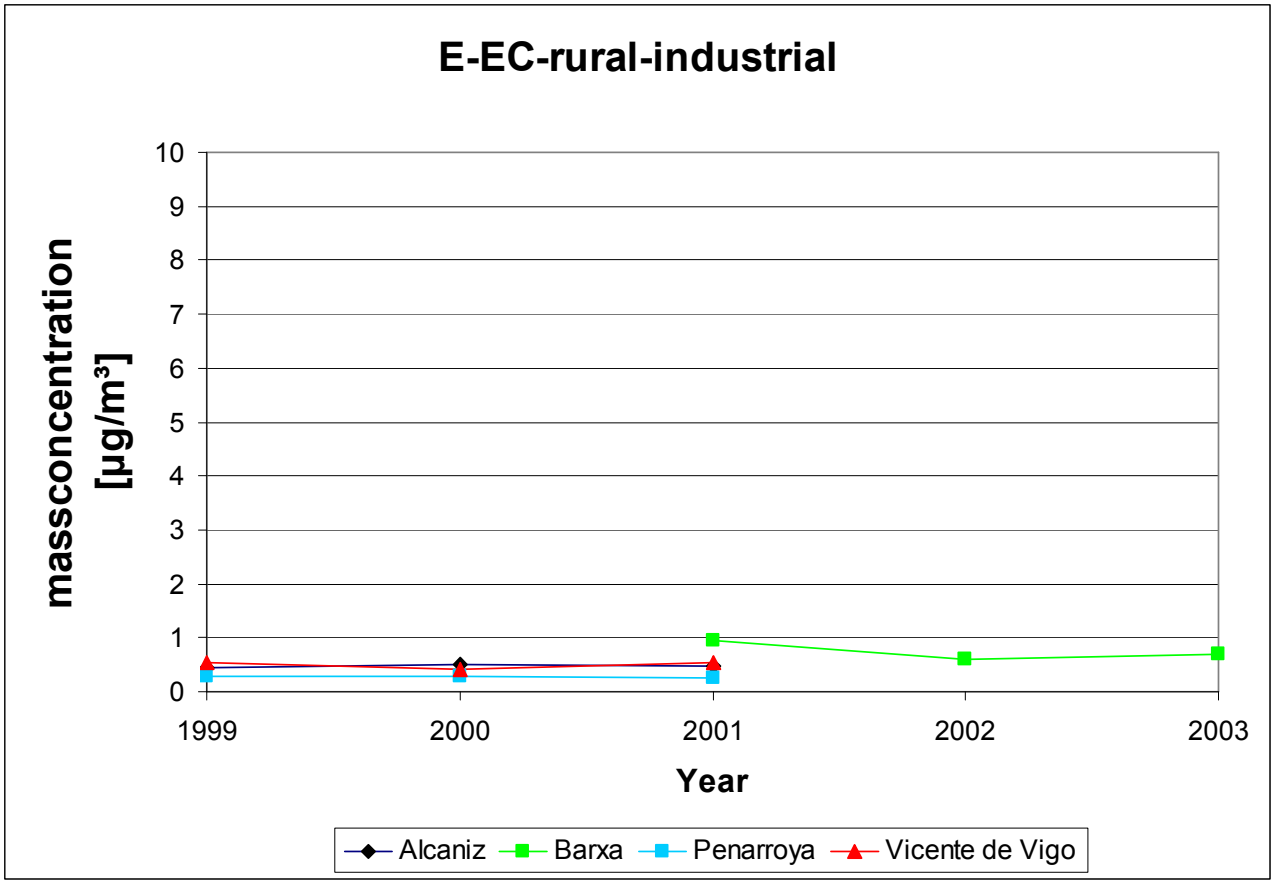

DK-EC-urban
masconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1967
1972
1977
1982
1987
1992
1997
2002
Year
Kopenhagen/Stormagade
Kopenhagen1
Kopenhagen2
Kopenhagen3
Kopenhagen4
Kopenhagen5
Kopenhagen6


E-EC-urban-background/industrial
masconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1986
1987
1988
1989
1990
1991
1992
Year
Background: Bilbao
Industrial: Sondika

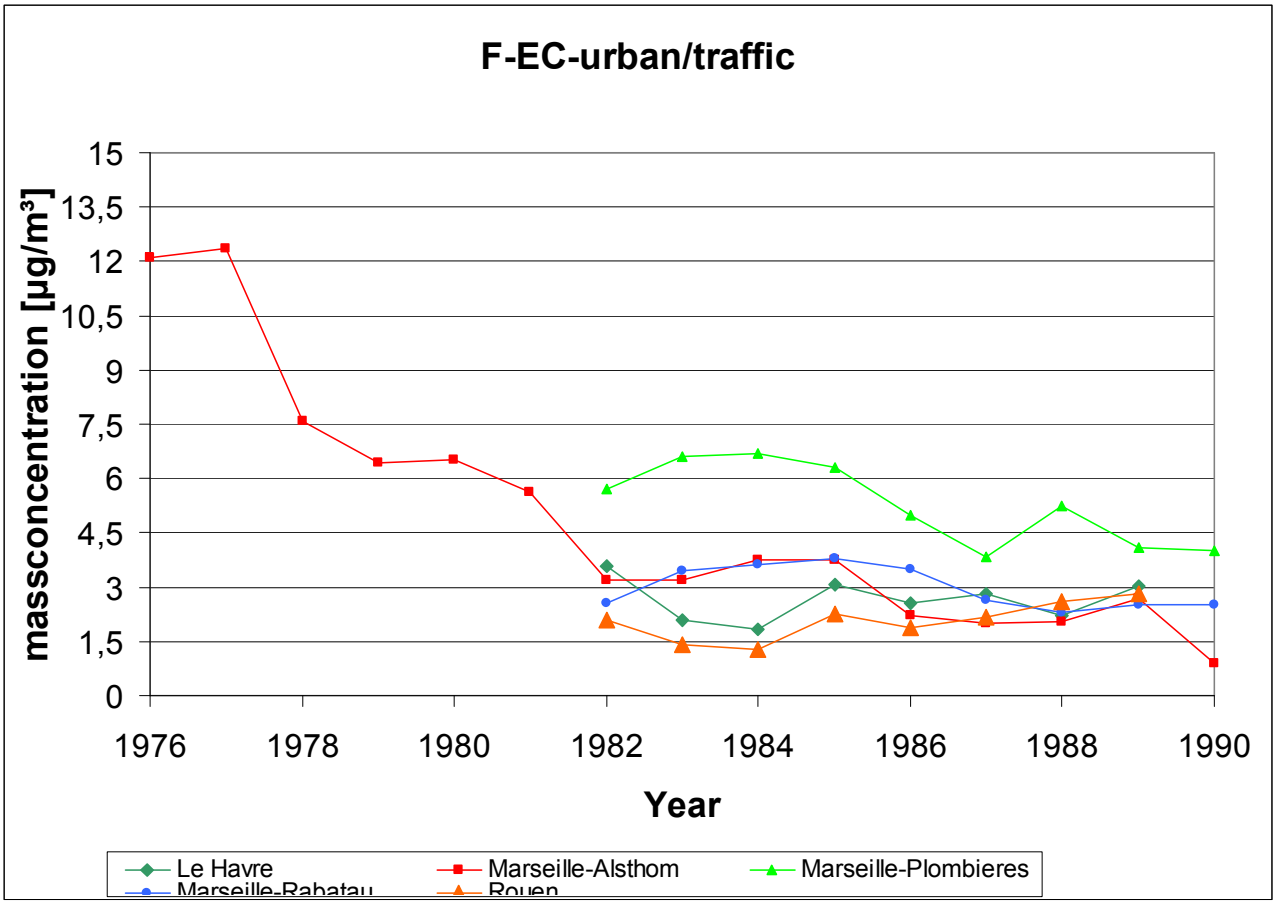
Spain

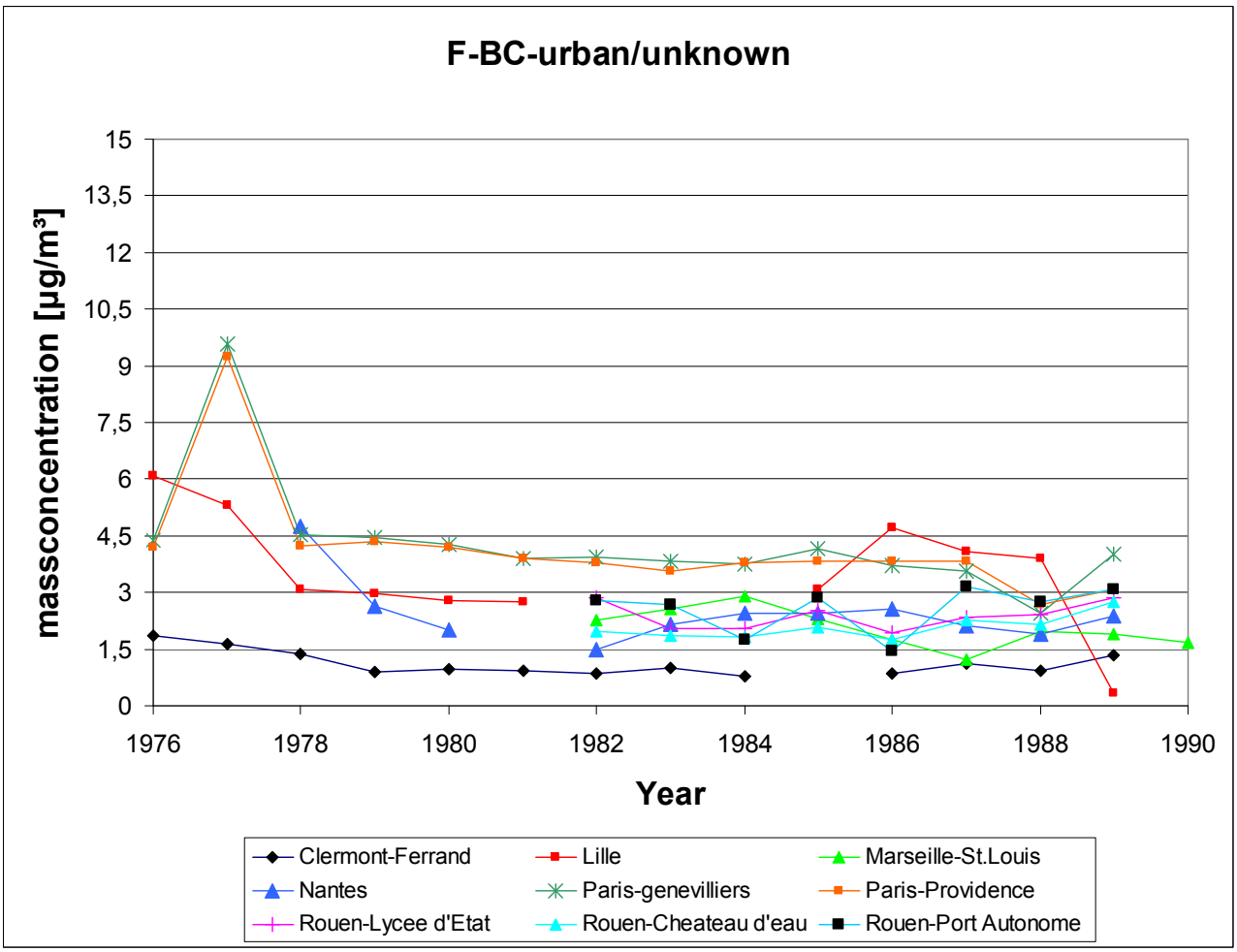

E-EC-urban-traffic
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1986
1988
1990
1992
1994
1996
1998
2000
2002
Year
Av.Madrid (Zaragoza)
Av.Valencia (Zaragoza)
Bilbao
Luis Montono
Luis Vives
Puente Virrey (Zaragoza)
San Jose
Zaragoza


E-EC-suburban
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1999
2000
2001
2002
2003
Year
Industrial: Andorra
Industrial: Escucha
Traffic: Valle Broto (Zaragoza)

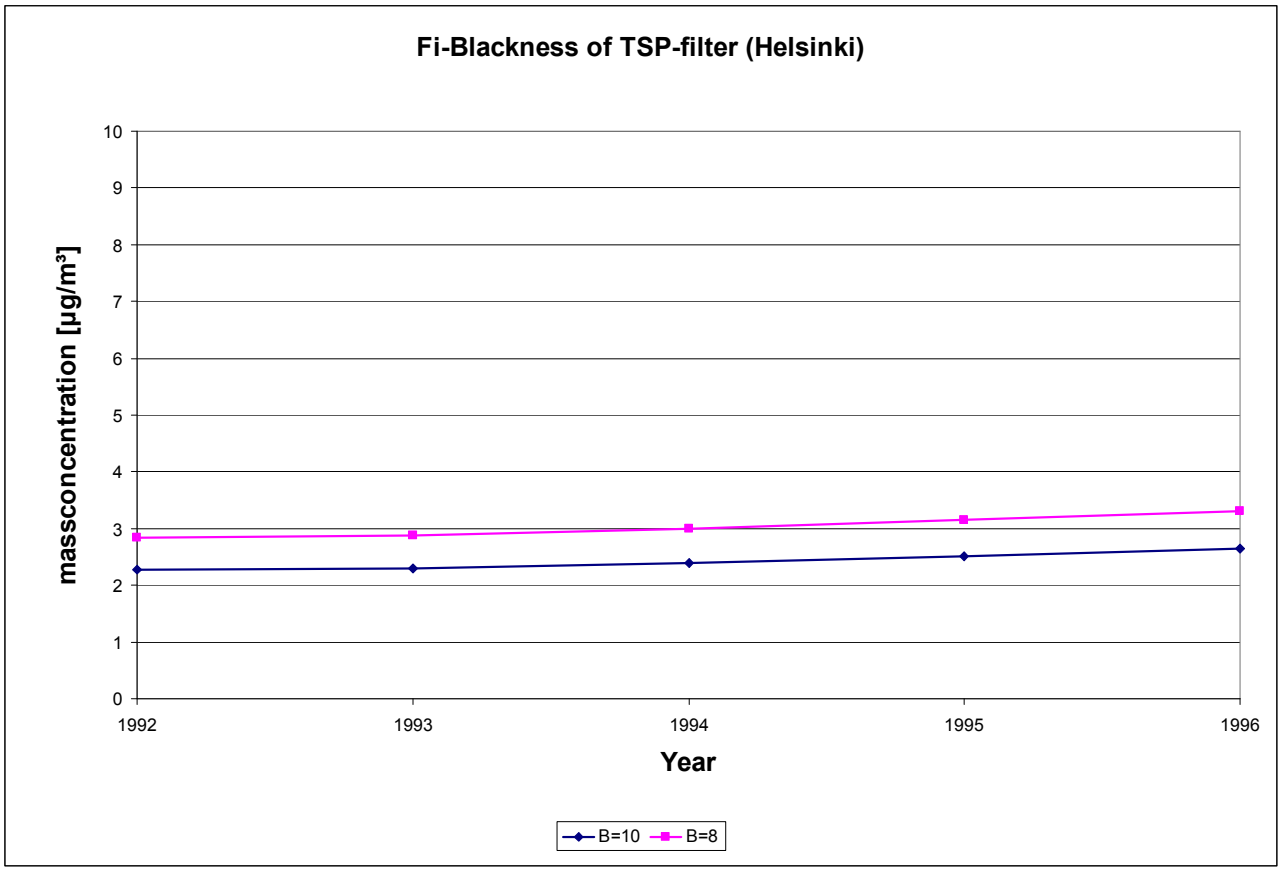

E-EC-rural-industrial
masconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1999
2000
2001
2002
2003
Year
Alcaniz
Barxa
Penarroya
Vicente de Vigo

France

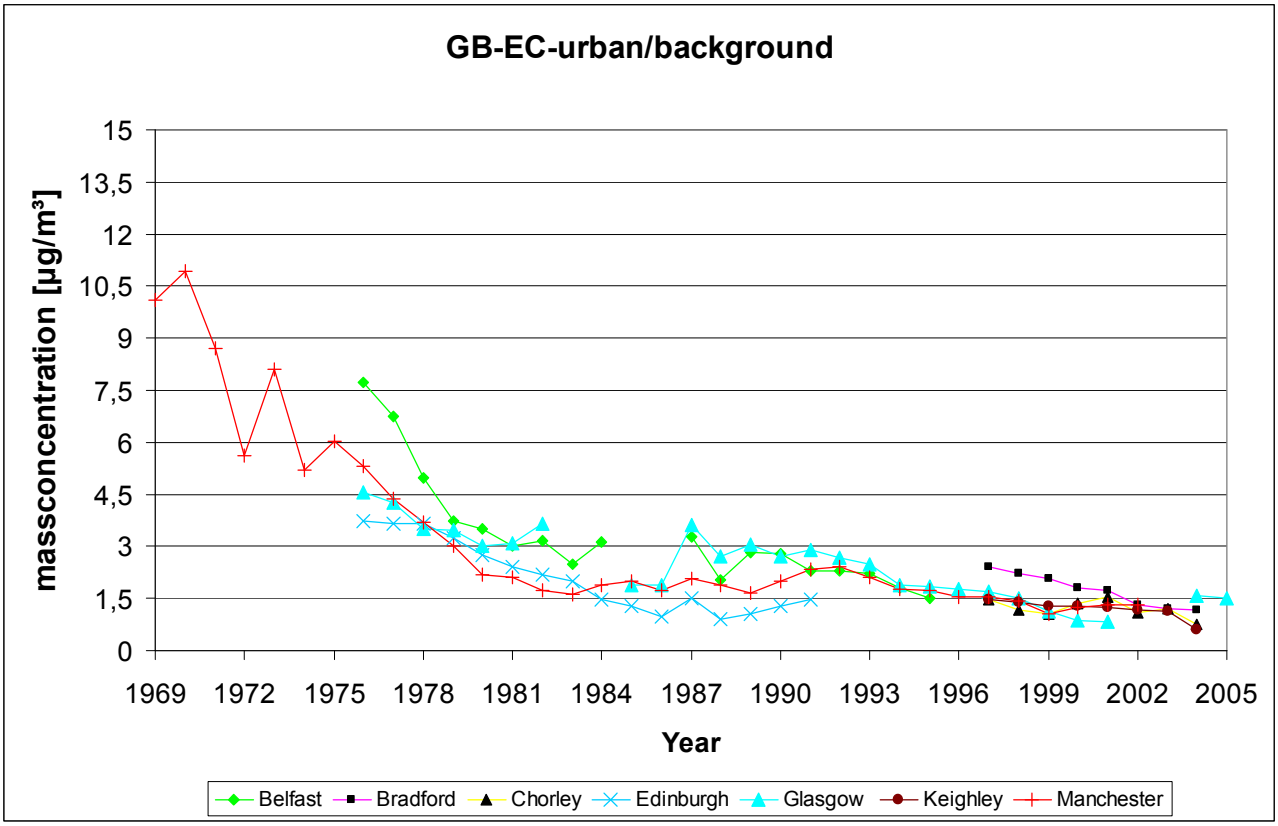

F-EC-urban/traffic
massconcentration [µg/m³]
15
13,5
12
10,5
9
7,5
6
4,5
3
1,5
0
1976
1978
1980
1982
1984
1986
1988
1990
Year
Le Havre
Marseille-Alsthom
Marseille-Plombieres
Marseille-Rabatau
Rouen

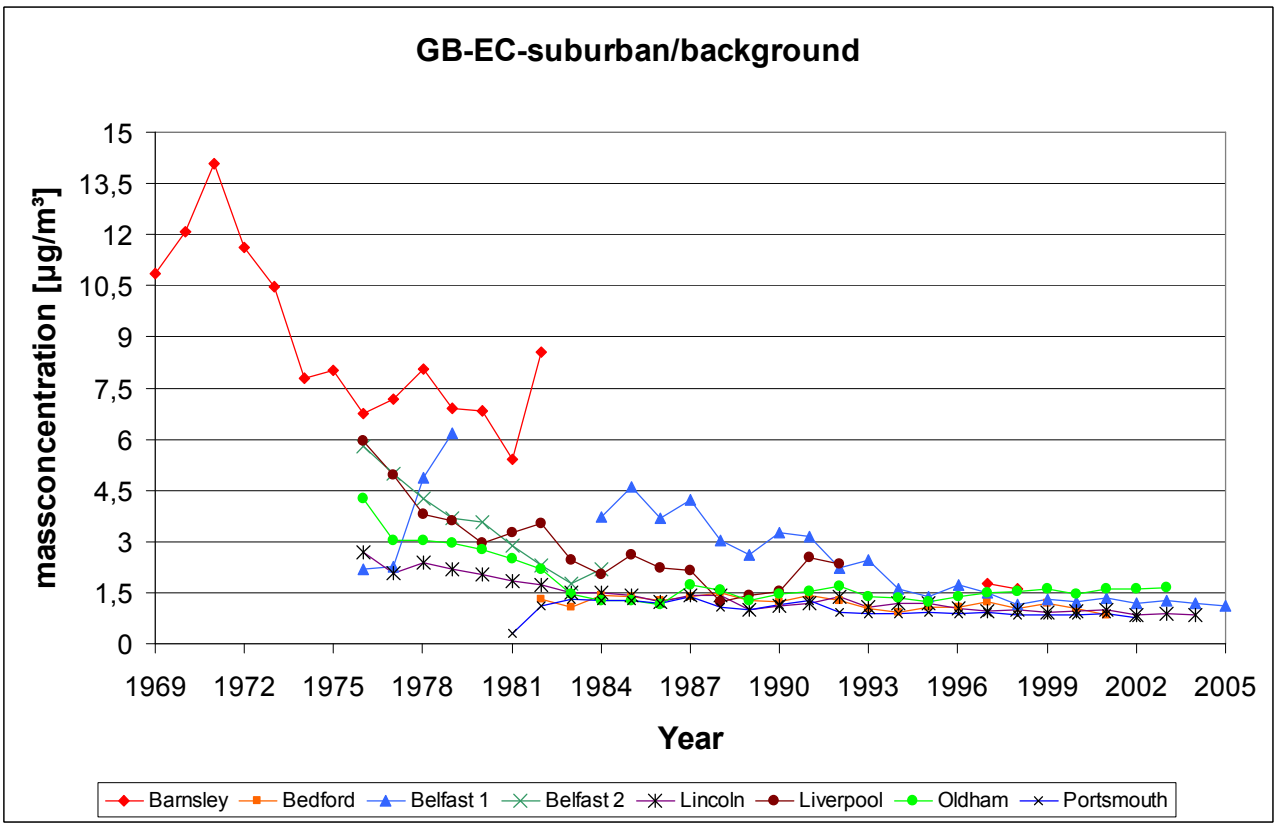

F-BC-urban/unknown
massconcentration [µg/m³]
15
13,5
12
10,5
9
7,5
6
4,5
3
1,5
0
1976
1978
1980
1982
1984
1986
1988
1990
Year
Clermont-Ferrand
Lille
Marseille-St.Louis
Nantes
Paris-genevilliers
Paris-Providence
Rouen-Lycee d'Etat
Rouen-Cheateau d'eau
Rouen-Port Autonome

Finland

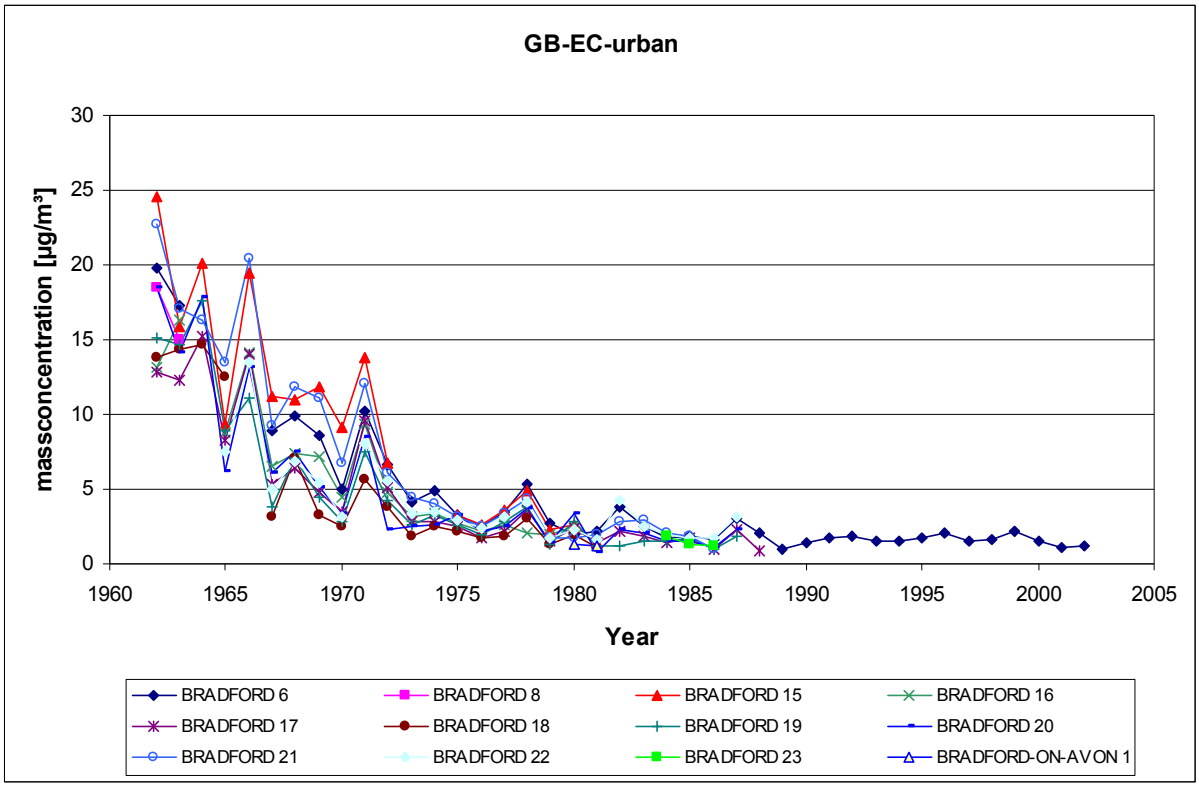

Fi-Blackness of TSP-filter (Helsinki)
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1992
1993
1994
1995
1996
Year
B=10
B=8

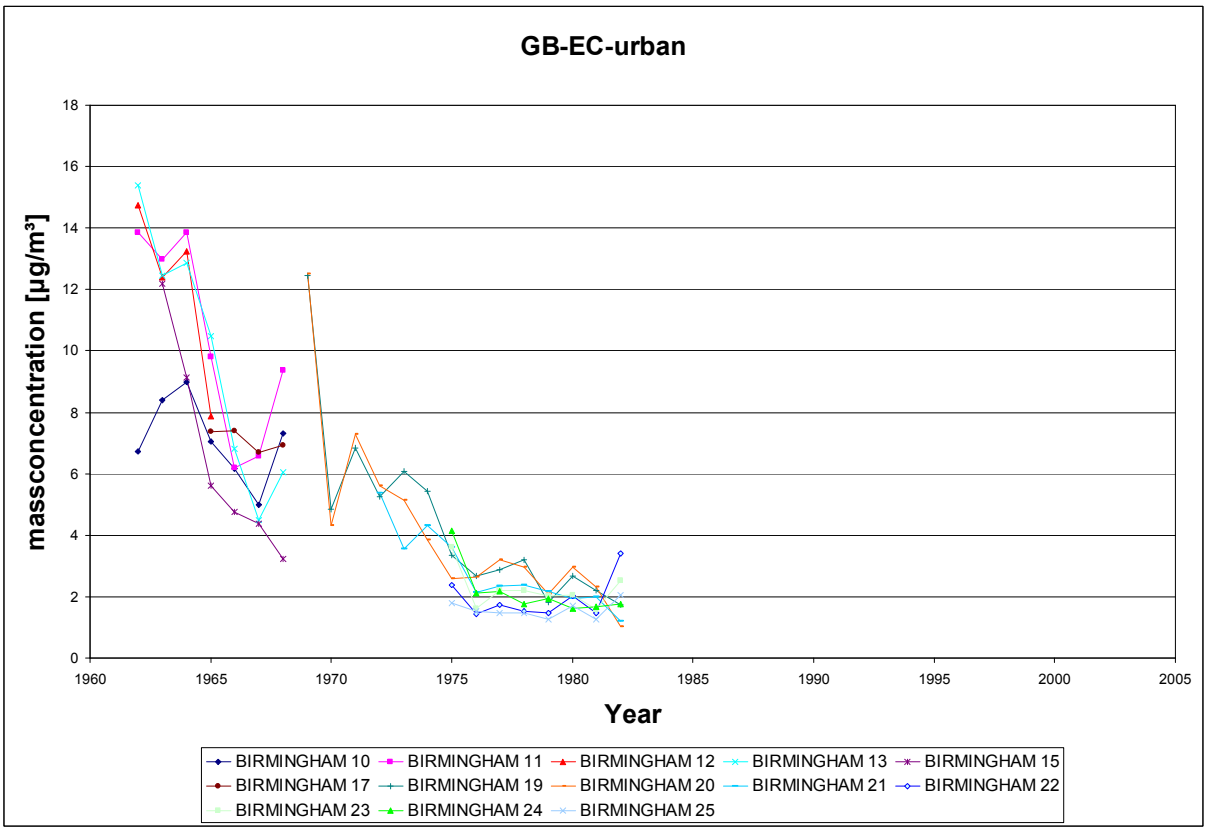
United Kingdom (AirNet data)

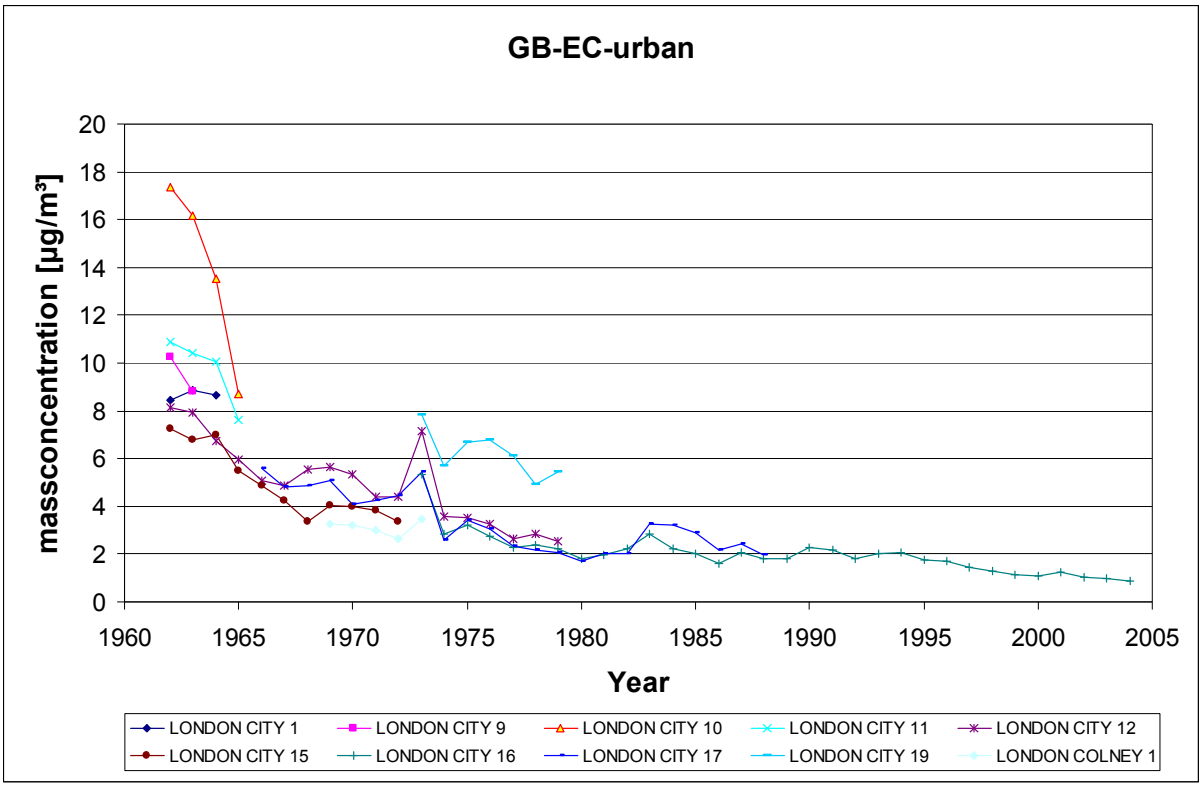


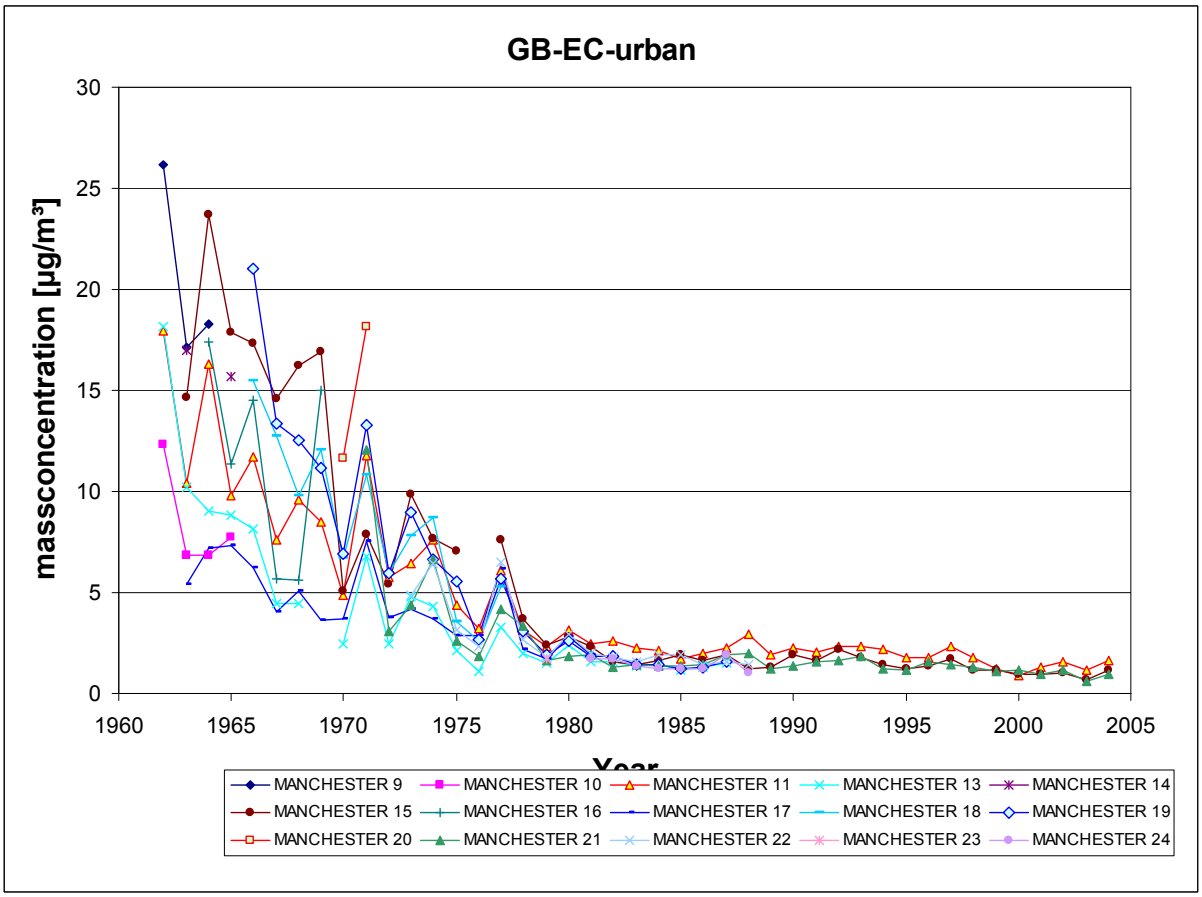


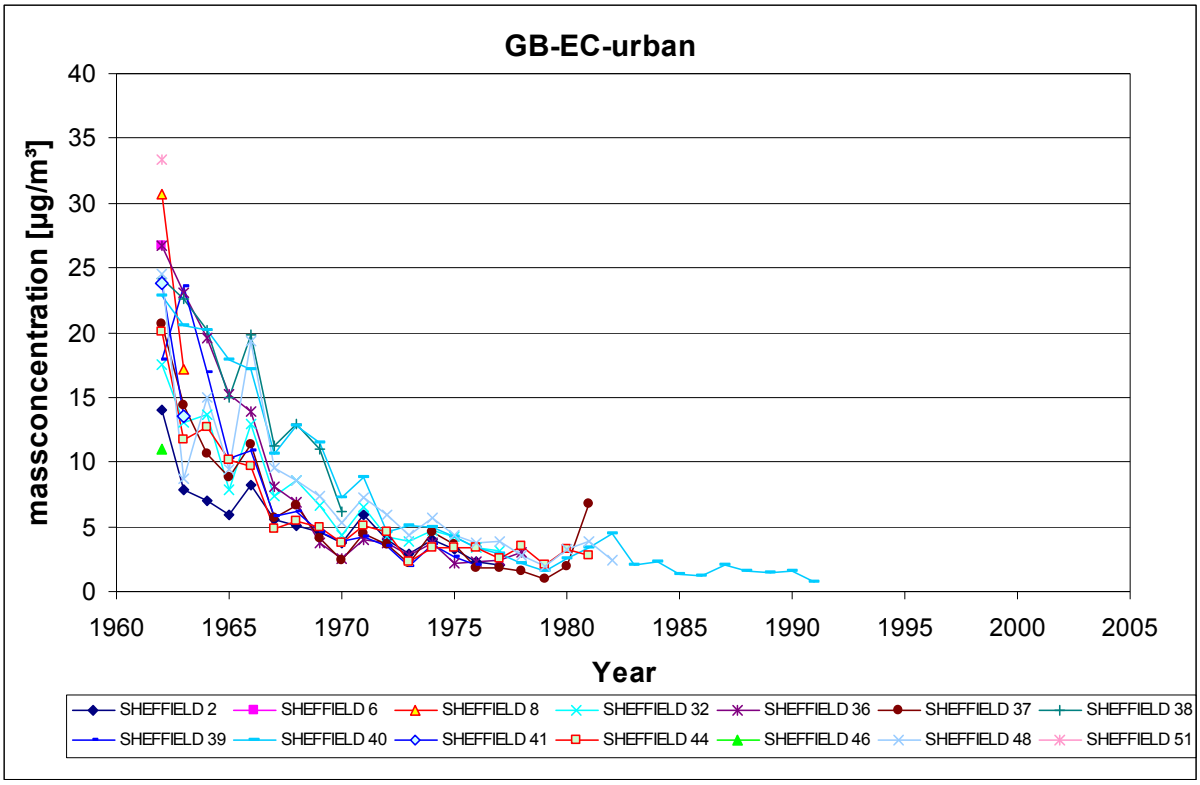
United Kingdom (Air Quality Archive data)

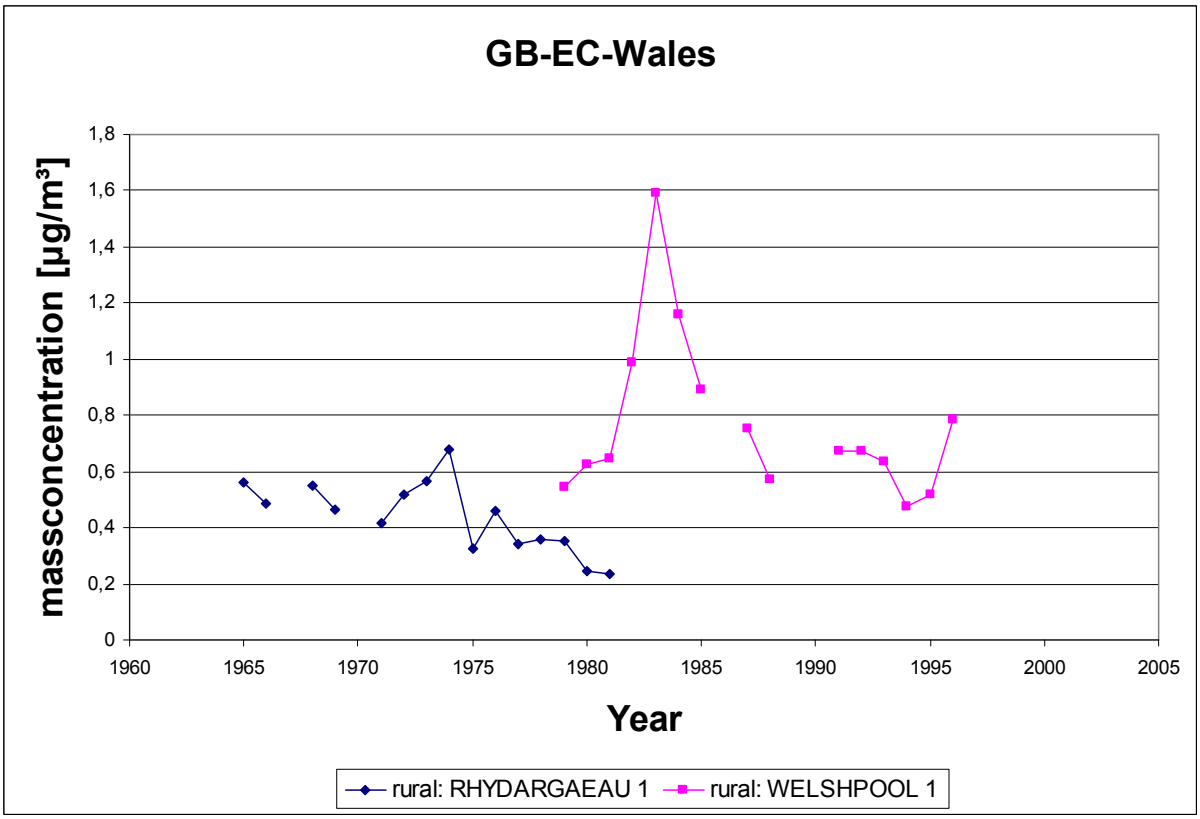


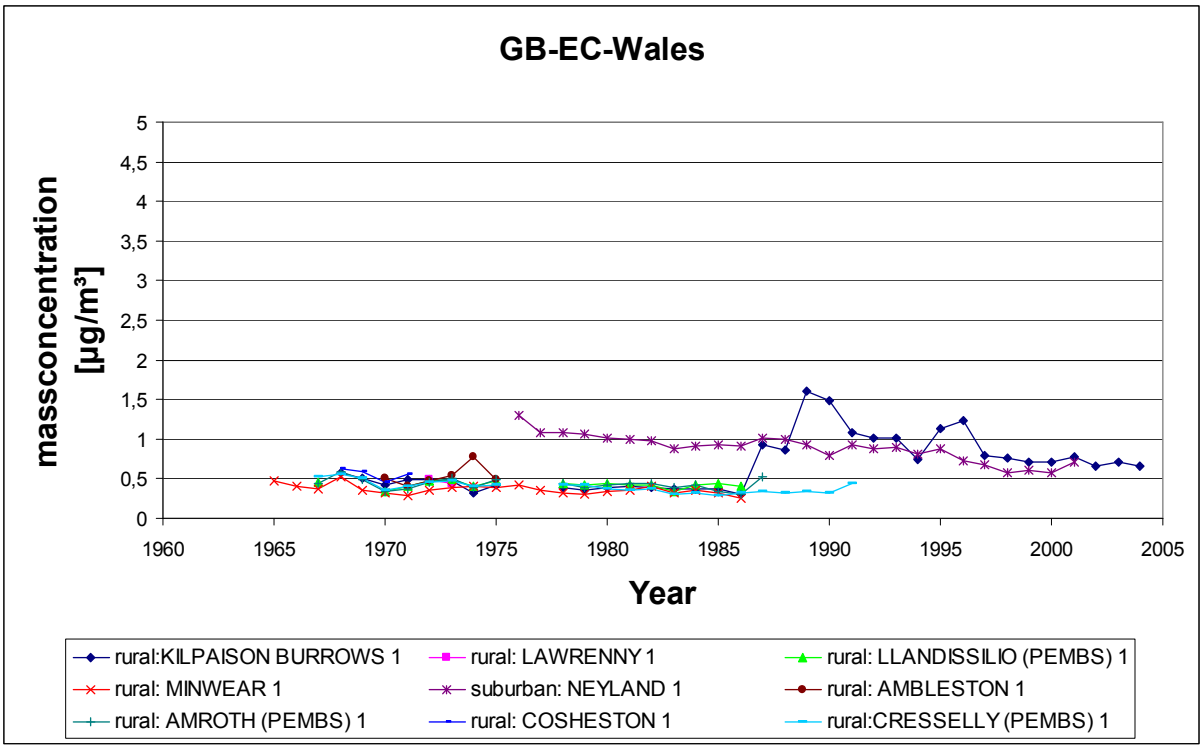


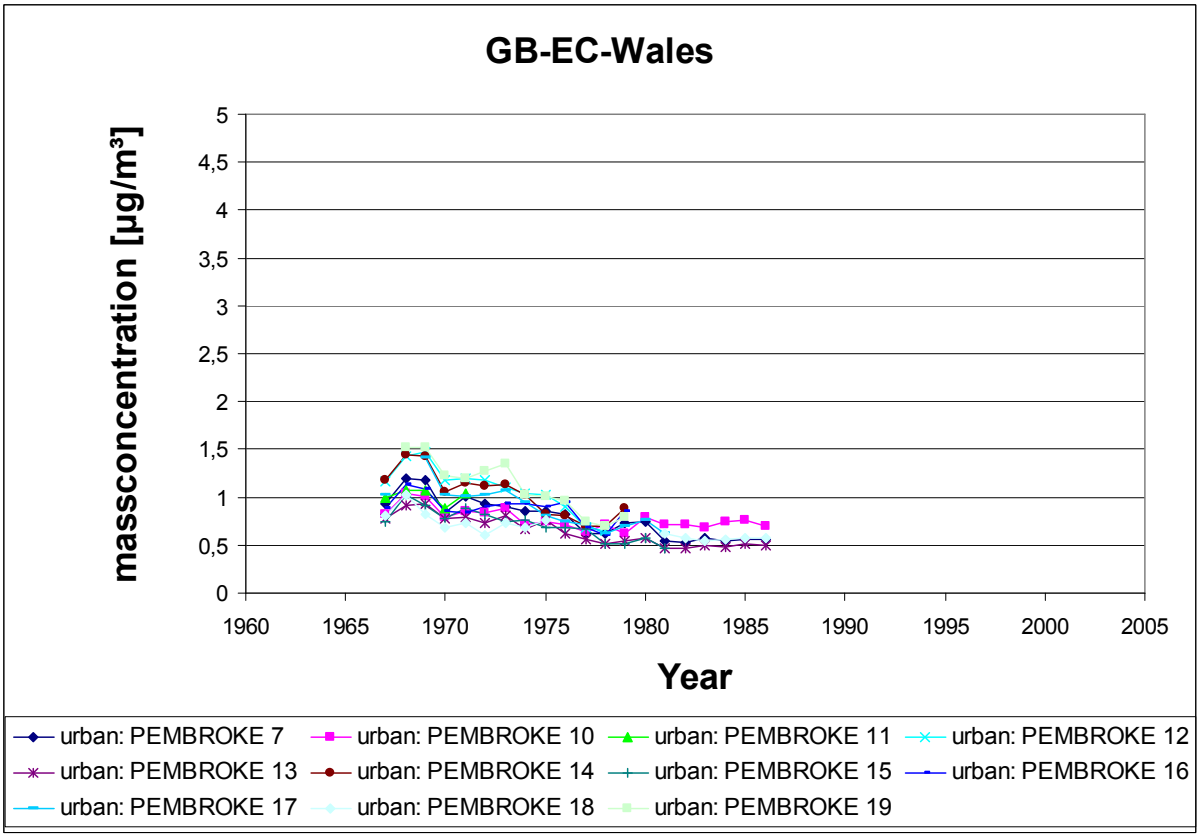

GB-EC-urban
massconcentration [µg/m³]
Year
LONDON CITY 1
LONDON CITY 9
LONDON CITY 10
LONDON CITY 11
LONDON CITY 12
LONDON CITY 15
LONDON CITY 16
LONDON CITY 17
LONDON CITY 19
LONDON COLNEY 1

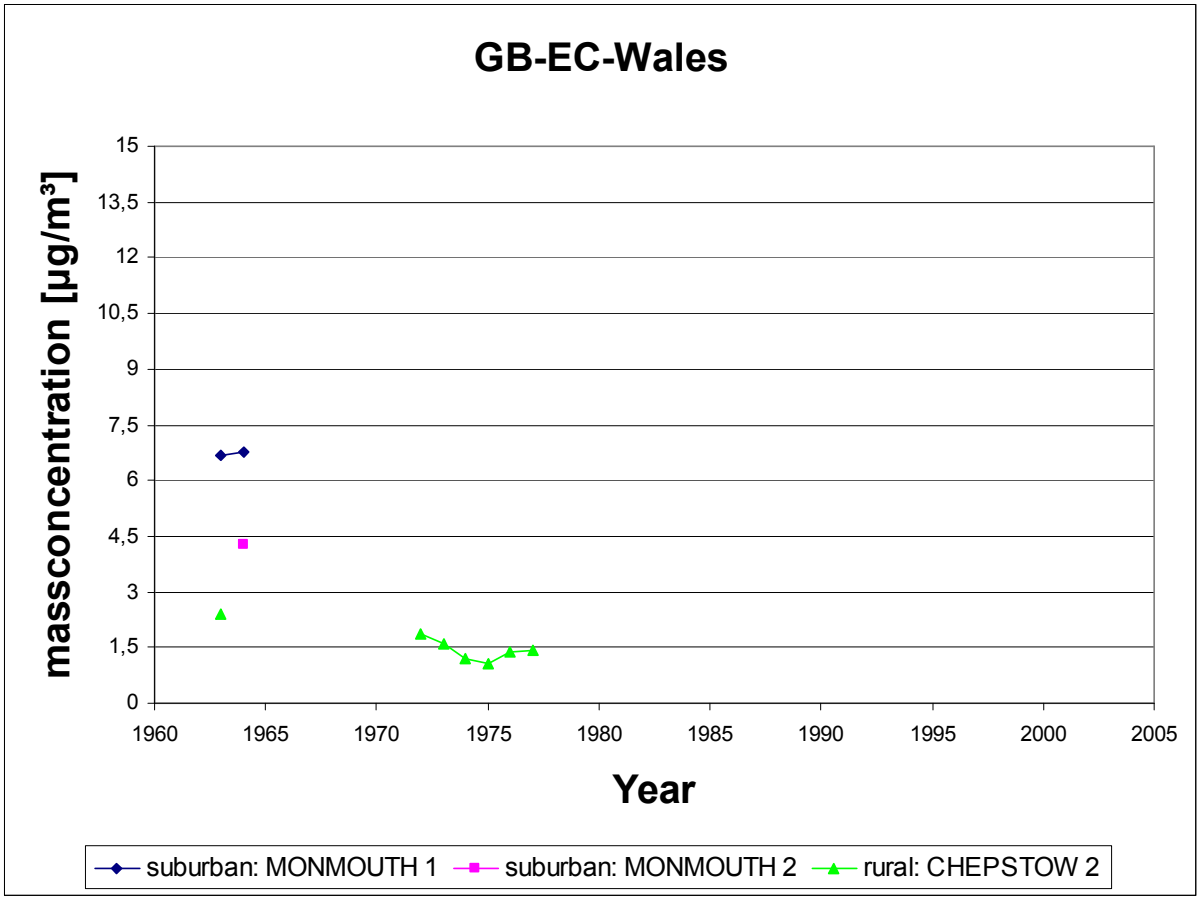

GB-EC-urban
massconcentration [µg/m³]
MANCHESTER 9
MANCHESTER 10
MANCHESTER 11
MANCHESTER 13
MANCHESTER 14
MANCHESTER 15
MANCHESTER 16
MANCHESTER 17
MANCHESTER 18
MANCHESTER 19
MANCHESTER 20
MANCHESTER 21
MANCHESTER 22
MANCHESTER 23
MANCHESTER 24

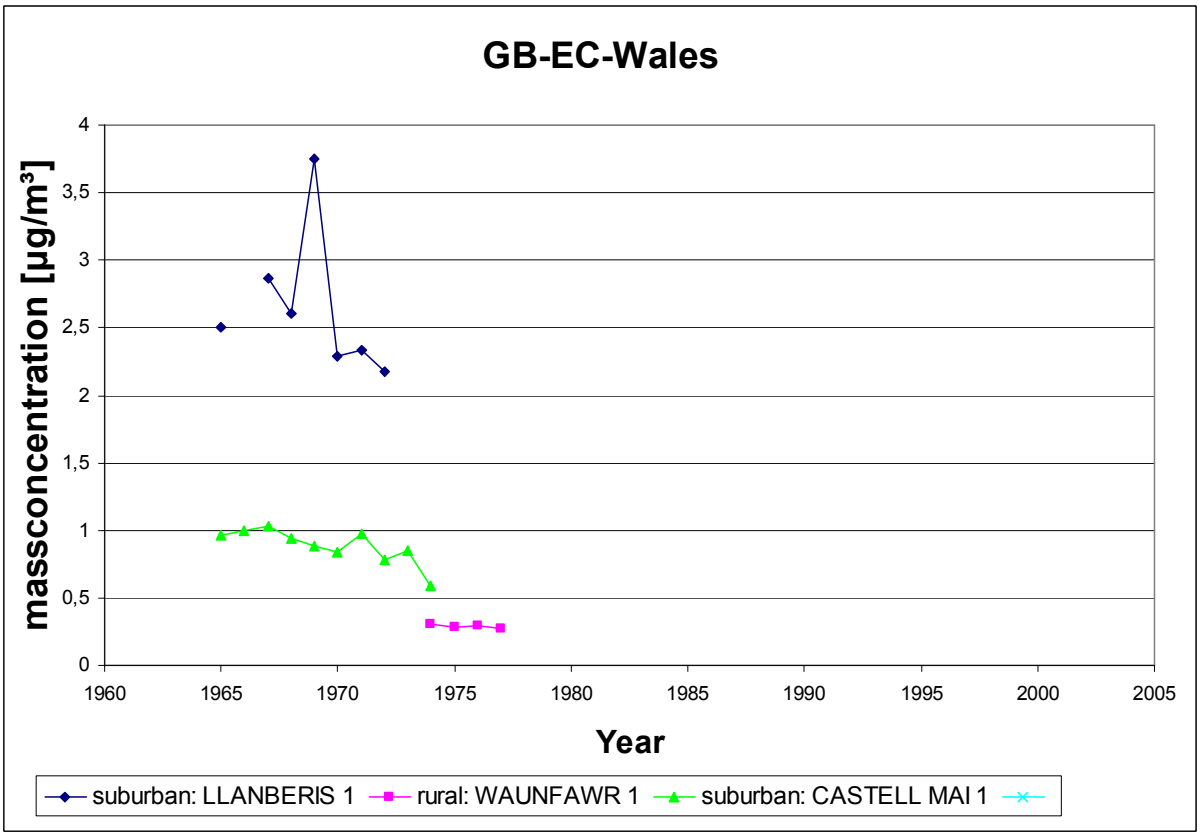

GB-EC-urban
massconcentration [µg/m³]
Year
SHEFFIELD 2
SHEFFIELD 6
SHEFFIELD 8
SHEFFIELD 32
SHEFFIELD 36
SHEFFIELD 37
SHEFFIELD 38
SHEFFIELD 39
SHEFFIELD 40
SHEFFIELD 41
SHEFFIELD 44
SHEFFIELD 46
SHEFFIELD 48
SHEFFIELD 51

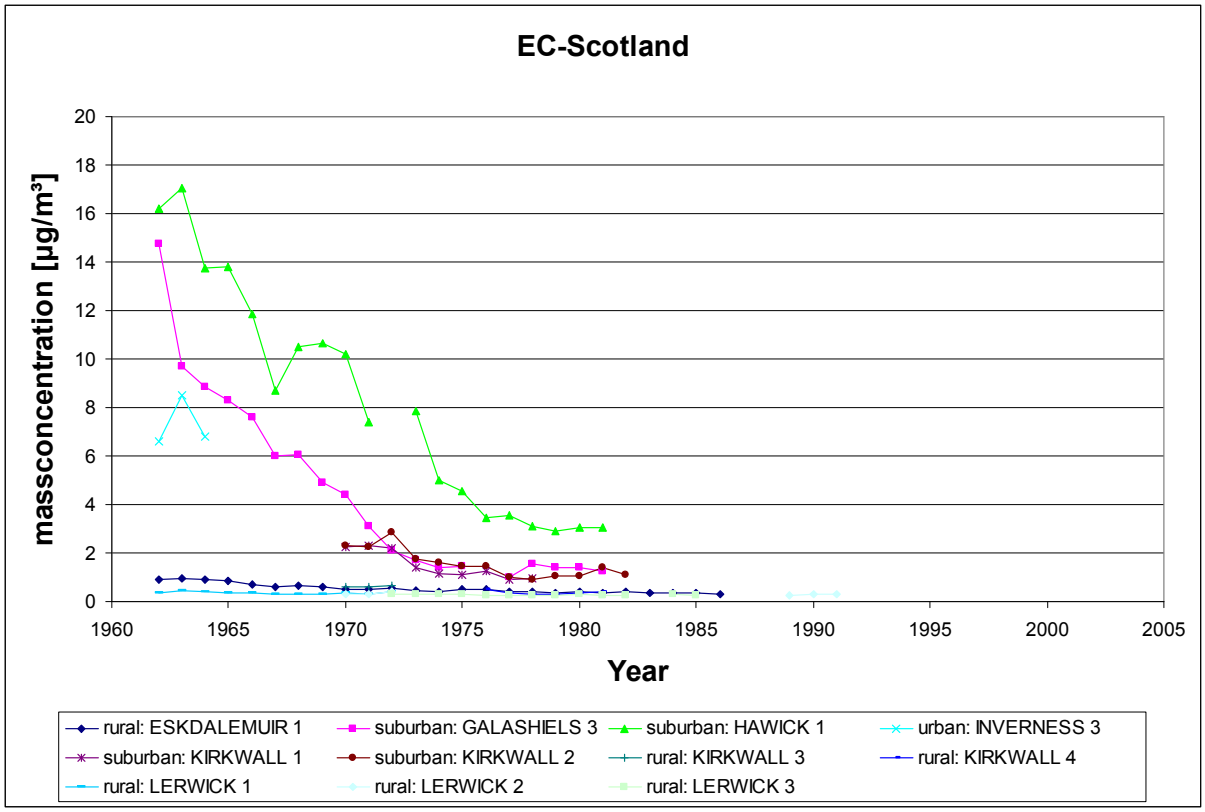

GB-EC-Wales
massconcentration [µg/m³]
Year
rural: RHYDARGAEAU 1
rural: WELSHPOOL 1

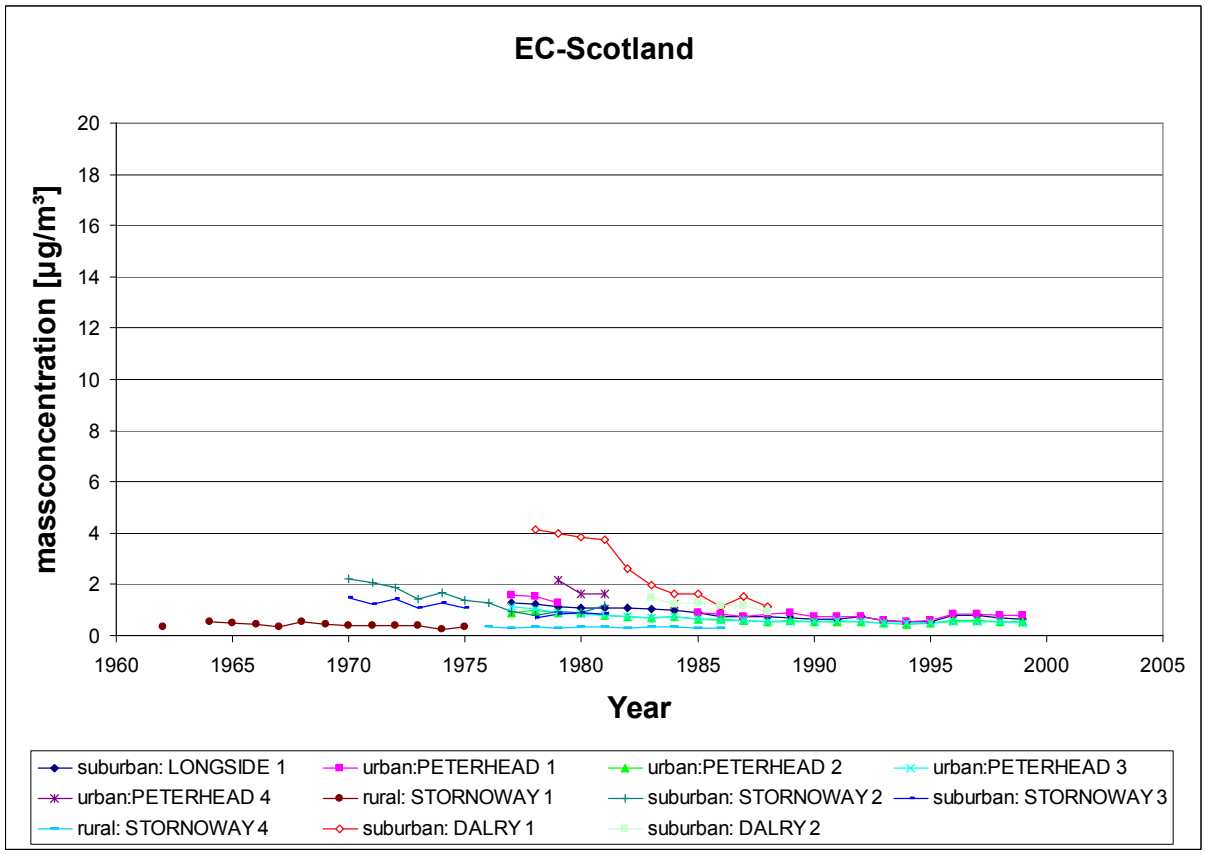

GB-EC-Wales
massconcentration [µg/m³]
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
rural:KILPAISON BURROWS 1
rural: LAWRENNY 1
rural: LLANDISSILIO (PEMBS) 1
rural: MINWEAR 1
suburban: NEYLAND 1
rural: AMBLESTON 1
rural: AMROTH (PEMBS) 1
rural: COSHESTON 1
rural:CRESSELLY (PEMBS) 1

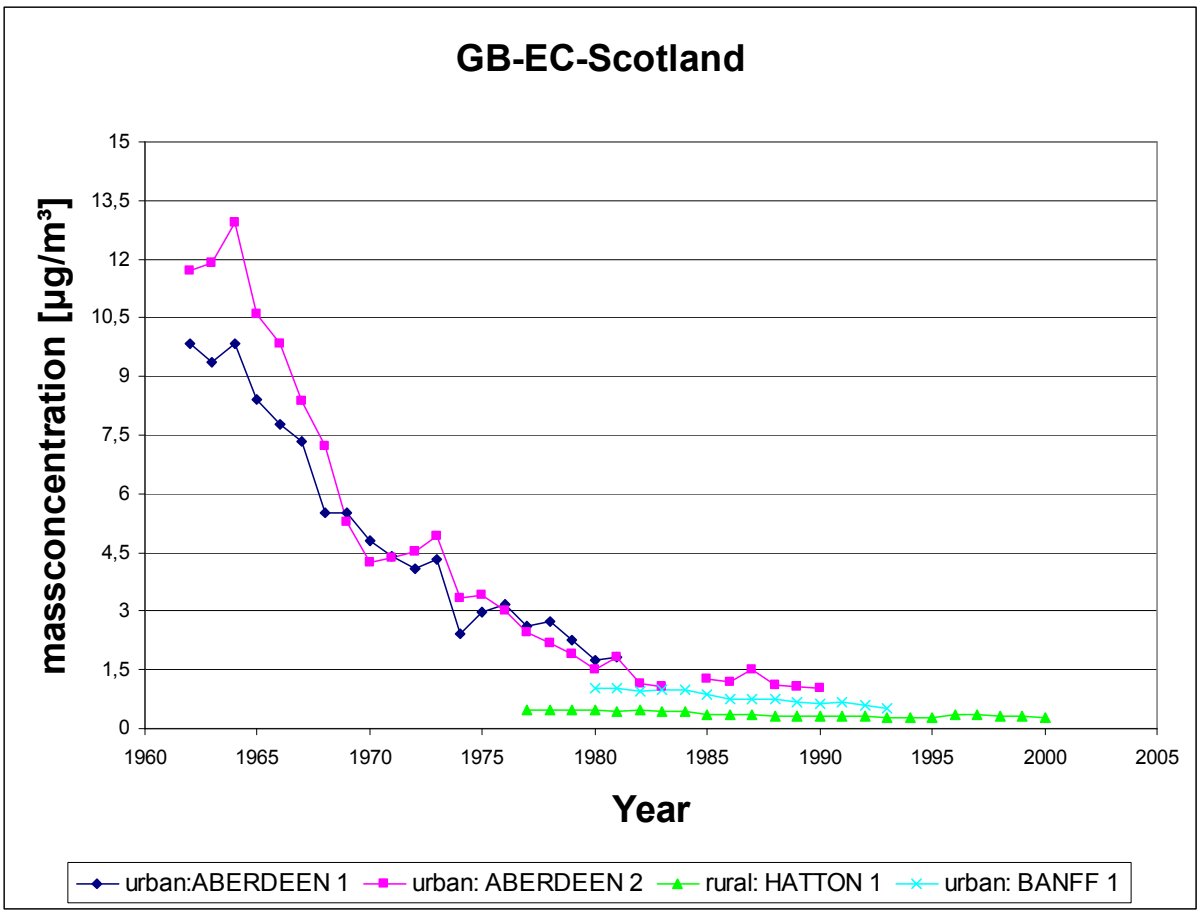

GB-EC-Wales
massconcentration [µg/m³]
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
urban: PEMBROKE 7
urban: PEMBROKE 10
urban: PEMBROKE 11
urban: PEMBROKE 12
urban: PEMBROKE 13
urban: PEMBROKE 14
urban: PEMBROKE 15
urban: PEMBROKE 16
urban: PEMBROKE 17
urban: PEMBROKE 18
urban: PEMBROKE 19

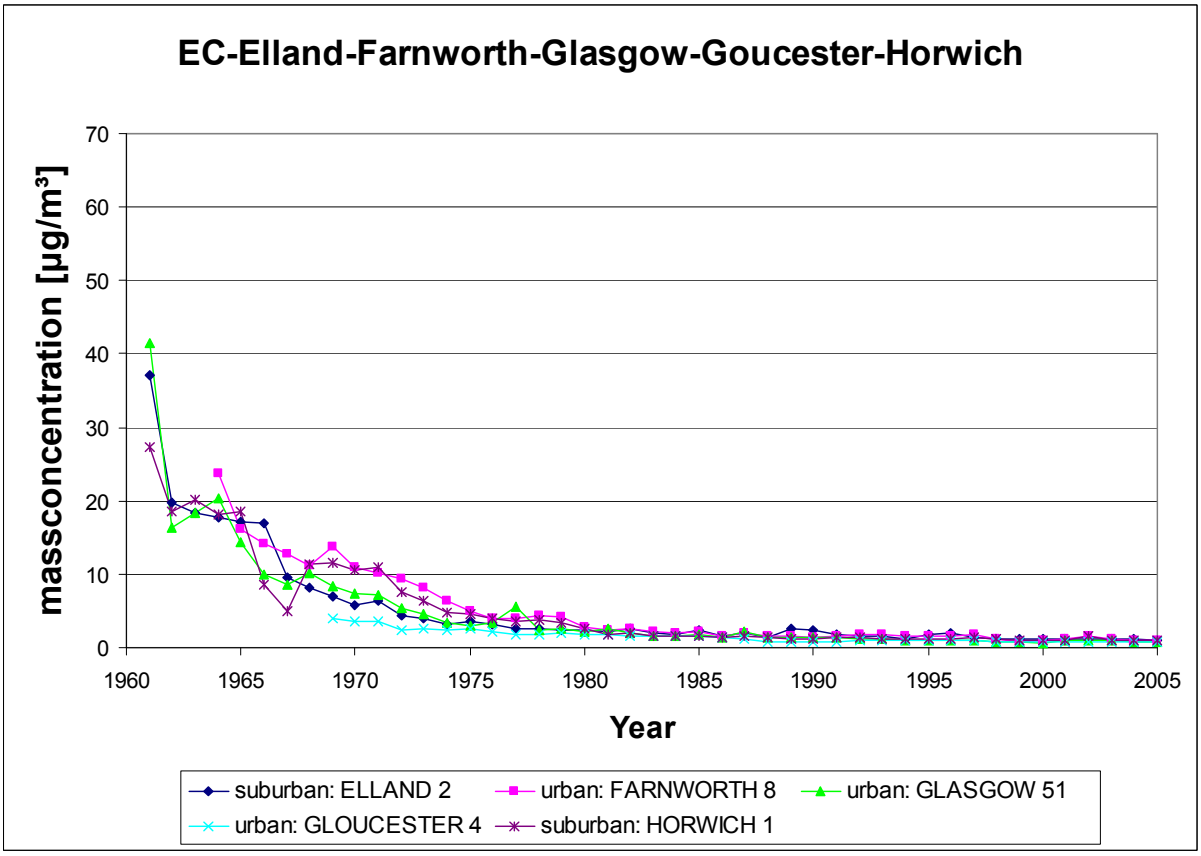

GB-EC-Wales
massconcentration [µg/m³]
15
13,5
12
10,5
9
7,5
6
4,5
3
1,5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
suburban: MONMOUTH 1
suburban: MONMOUTH 2
rural: CHEPSTOW 2

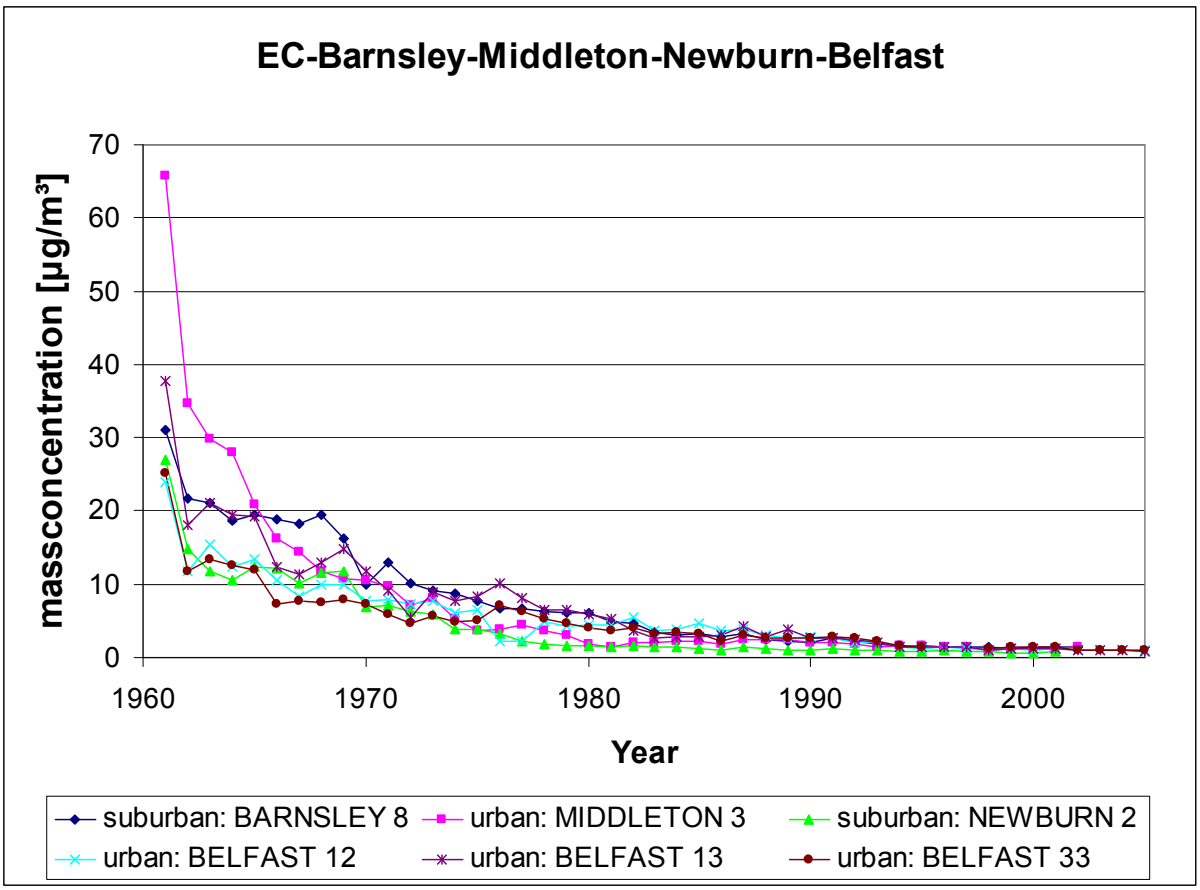

GB-EC-Wales
massconcentration [µg/m³]
4
3,5
3
2,5
2
1,5
1
0,5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
suburban: LLANBERIS 1
rural: WAUNFAWR 1
suburban: CASTELL MAI 1

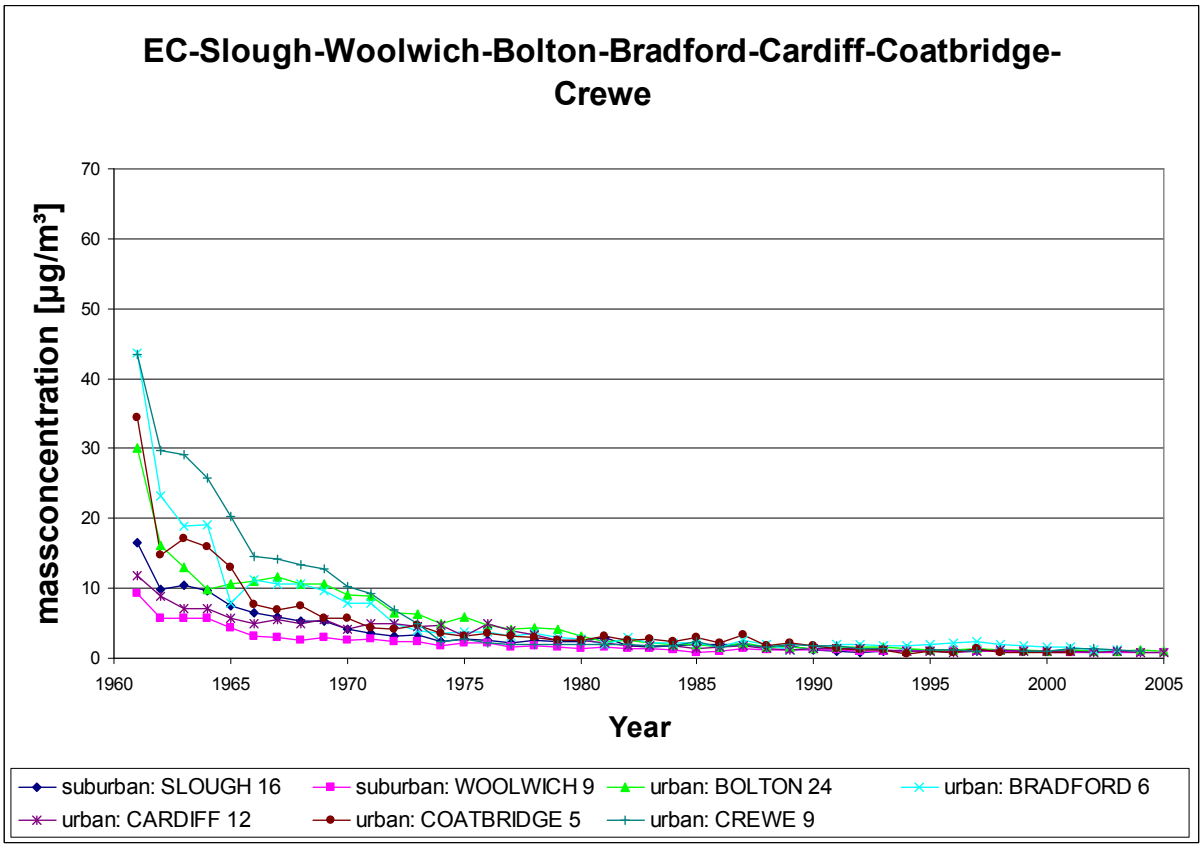

EC-Scotland
massconcentration [µg/m³]
Year
rural: ESKDALEMUIR 1
suburban: GALASHIELS 3
suburban: HAWICK 1
urban: INVERNESS 3
suburban: KIRKWALL 1
suburban: KIRKWALL 2
rural: KIRKWALL 3
rural: KIRKWALL 4
rural: LERWICK 1
rural: LERWICK 2
rural: LERWICK 3


EC-Scotland
massconcentration [µg/m³]
Year
suburban: LONGSIDE 1
urban:PETERHEAD 1
urban:PETERHEAD 2
urban:PETERHEAD 3
urban:PETERHEAD 4
rural: STORNOWAY 1
suburban: STORNOWAY 2
suburban: STORNOWAY 3
rural: STORNOWAY 4
suburban: DALRY 1
suburban: DALRY 2

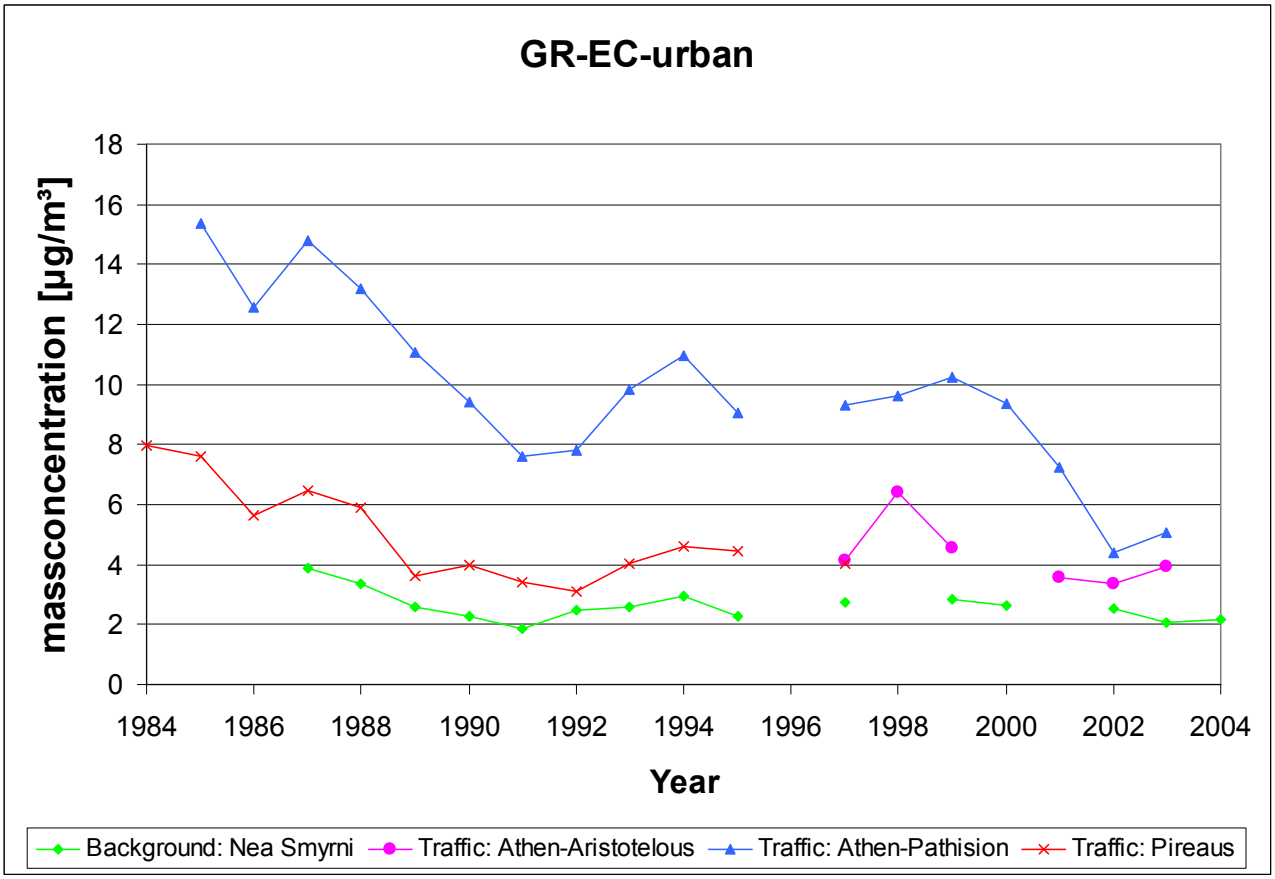

GB-EC-Scotland
massconcentration [µg/m³]
15
13,5
12
10,5
9
7,5
6
4,5
3
1,5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
urban:ABERDEEN 1
urban: ABERDEEN 2
rural: HATTON 1
urban: BANFF 1


EC-Elland-Farnworth-Glasgow-Goucester-Horwich
massconcentration [µg/m³]
70
60
50
40
30
20
10
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
suburban: ELLAND 2
urban: FARNWORTH 8
urban: GLASGOW 51
urban: GLOUCESTER 4
suburban: HORWICH 1

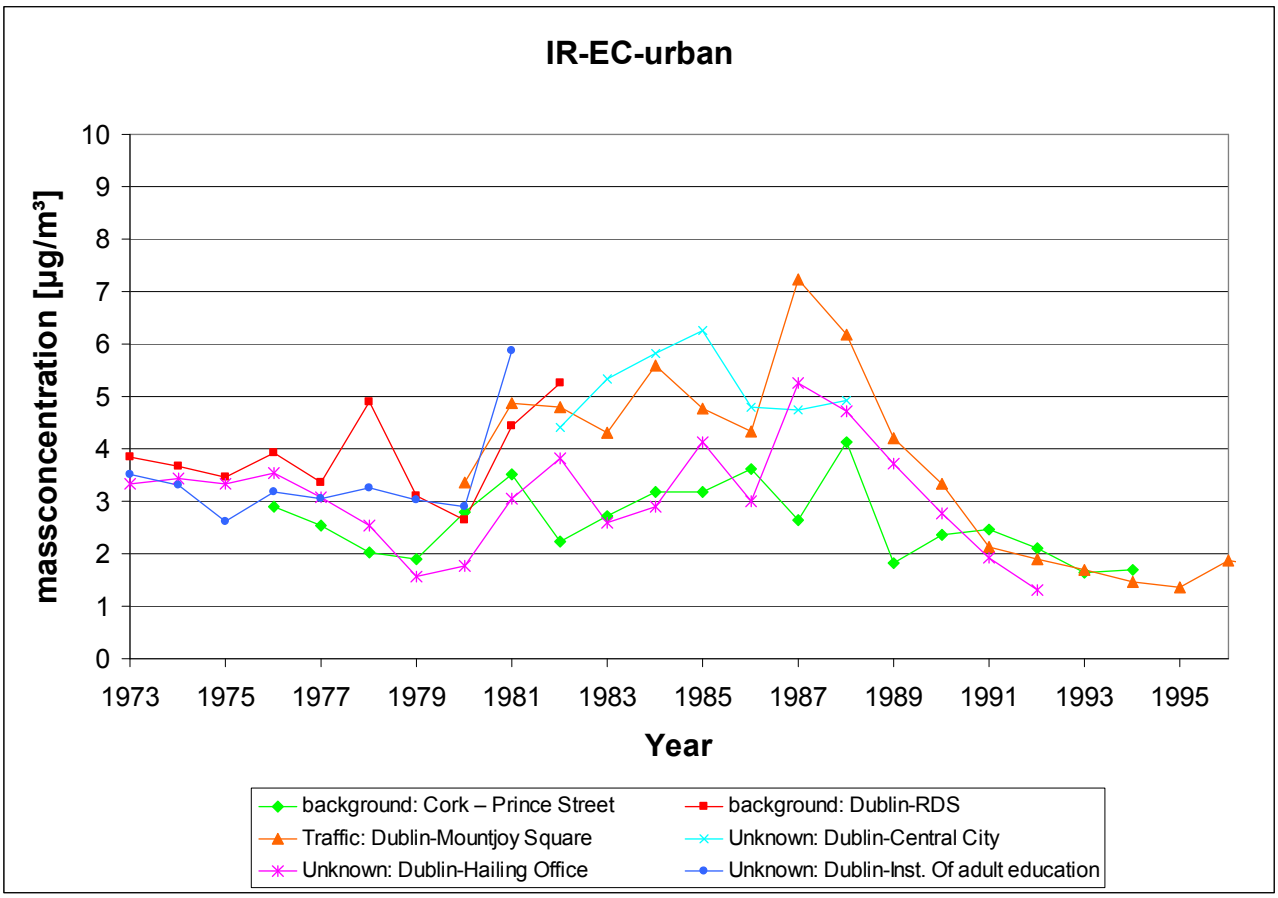

EC-Barnsley-Middleton-Newburn-Belfast
massconcentration [µg/m³]
70
60
50
40
30
20
10
0
1960
1970
1980
1990
2000
Year
suburban: BARNSLEY 8
urban: MIDDLETON 3
suburban: NEWBURN 2
urban: BELFAST 12
urban: BELFAST 13
urban: BELFAST 33

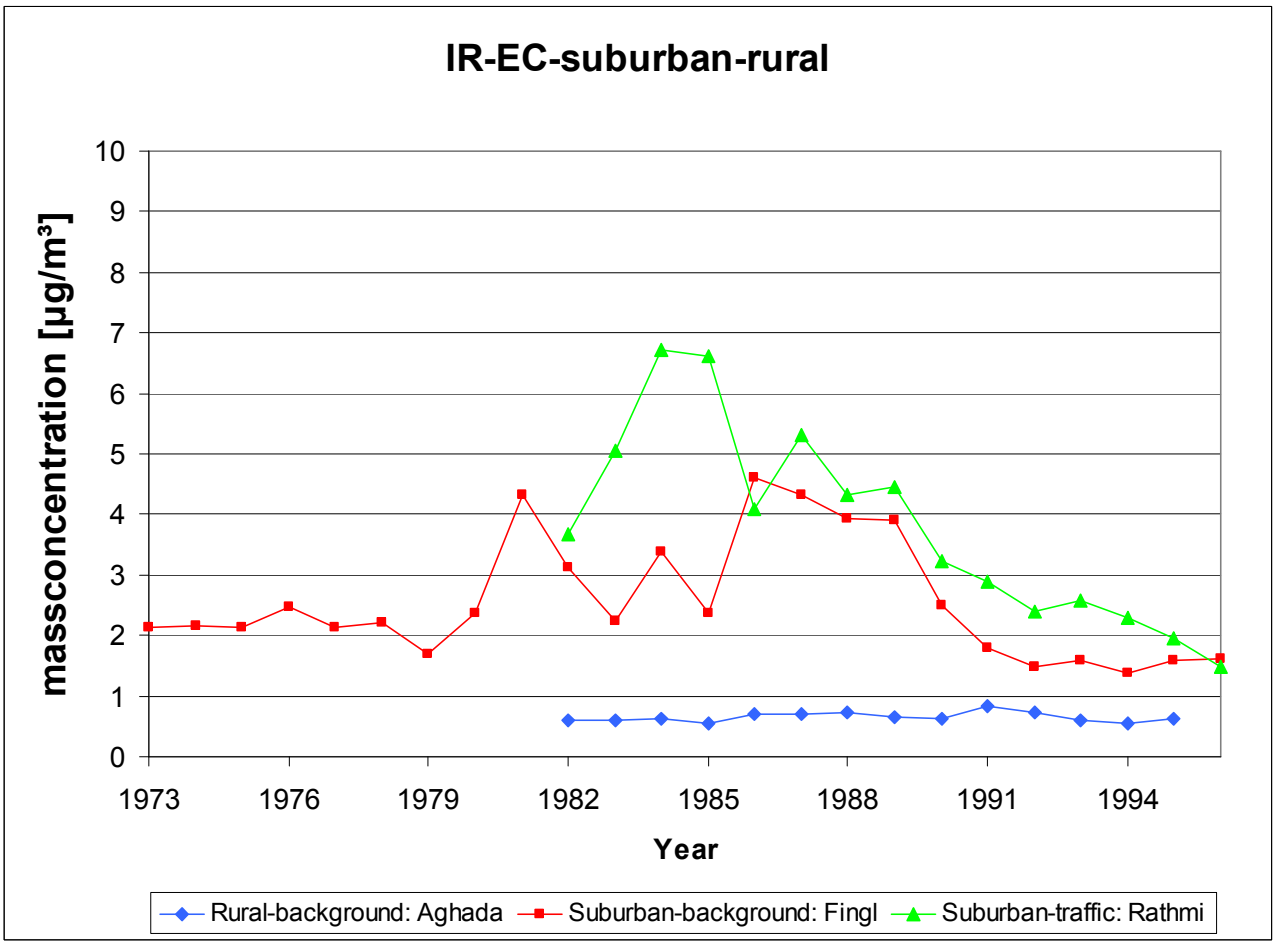

EC-Slough-Woolwich-Bolton-Bradford-Cardiff-Coatbridge-Crewe
massconcentration [µg/m³]
70
60
50
40
30
20
10
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Year
suburban: SLOUGH 16
suburban: WOOLWICH 9
urban: BOLTON 24
urban: BRADFORD 6
urban: CARDIFF 12
urban: COATBRIDGE 5
urban: CREWE 9

Greece

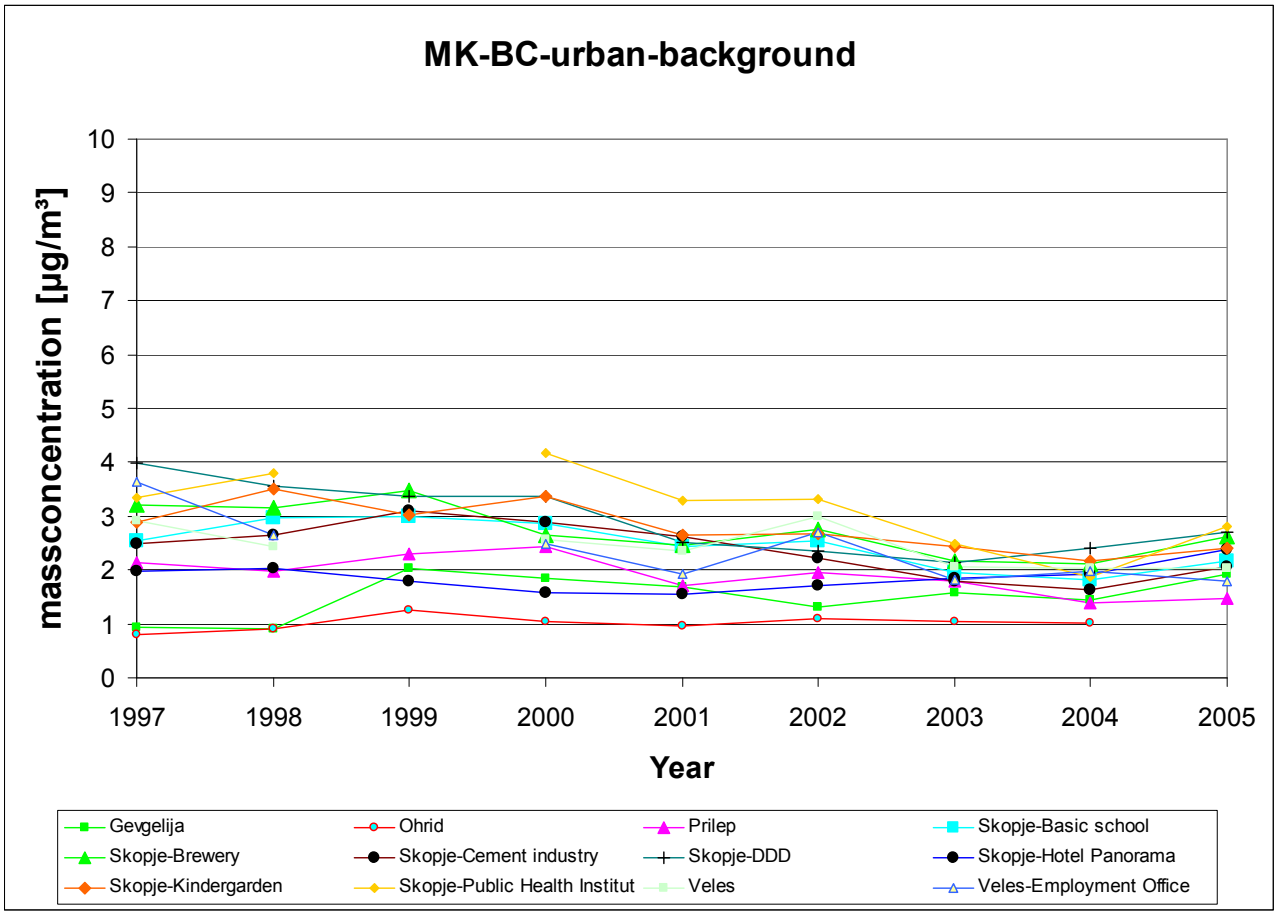

GR-EC-urban
massconcentration [µg/m³]
18
16
14
12
10
8
6
4
2
0
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Year
Background: Nea Smyrni
Traffic: Athen-Aristotelous
Traffic: Athen-Pathision
Traffic: Pireaus

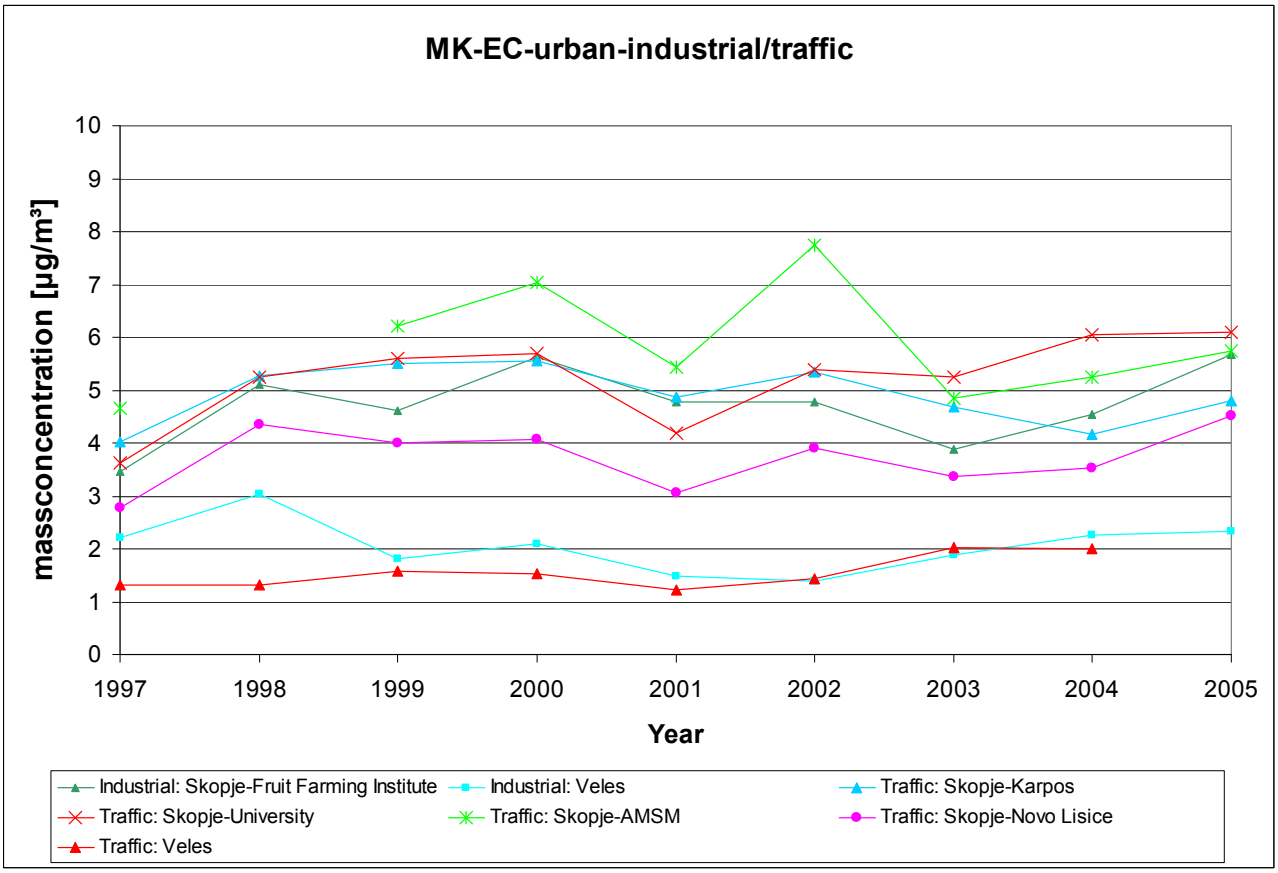
Ireland

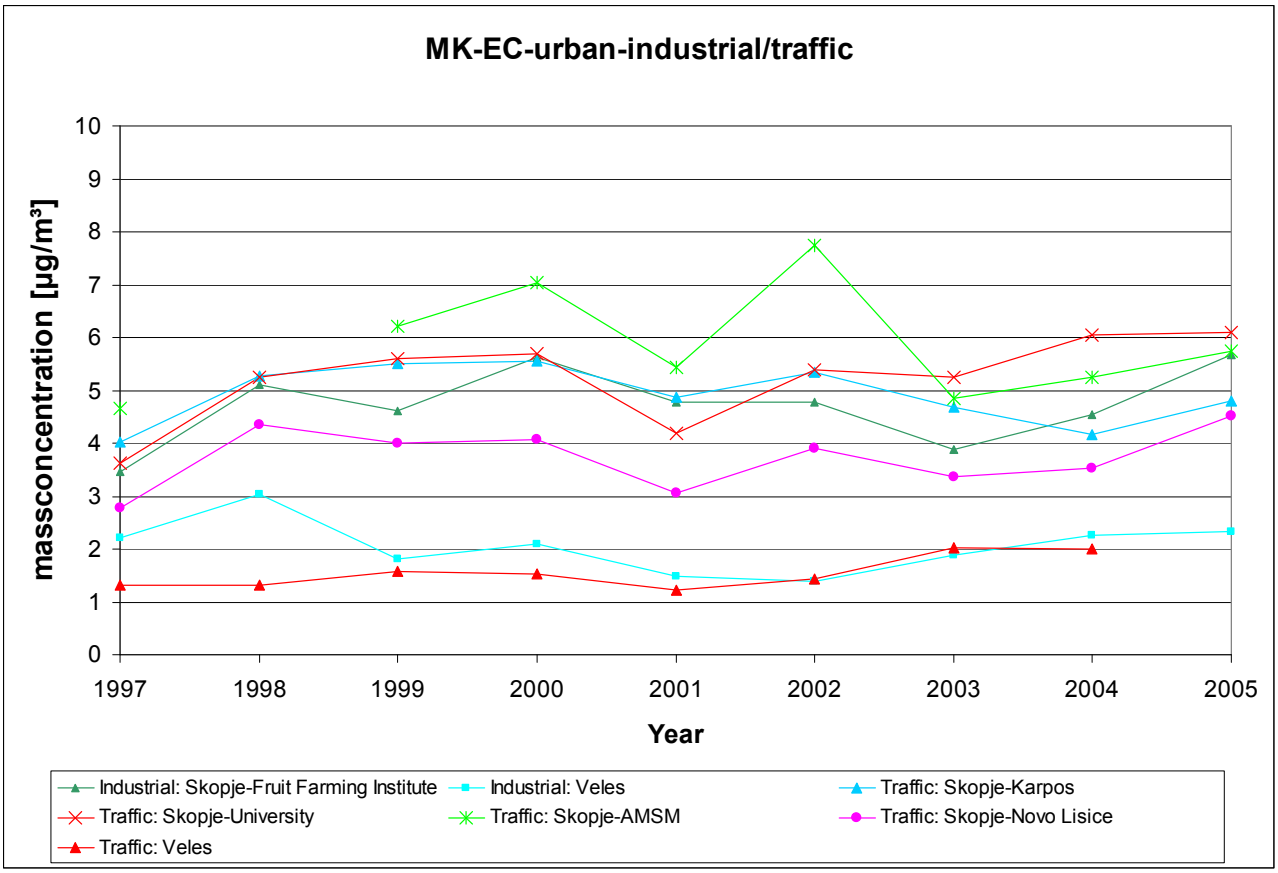

IR-EC-urban
masconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
Year
background: Cork – Prince Street
background: Dublin-RDS
Traffic: Dublin-Mountjoy Square
Unknown: Dublin-Central City
Unknown: Dublin-Hailing Office
Unknown: Dublin-Inst. Of adult education

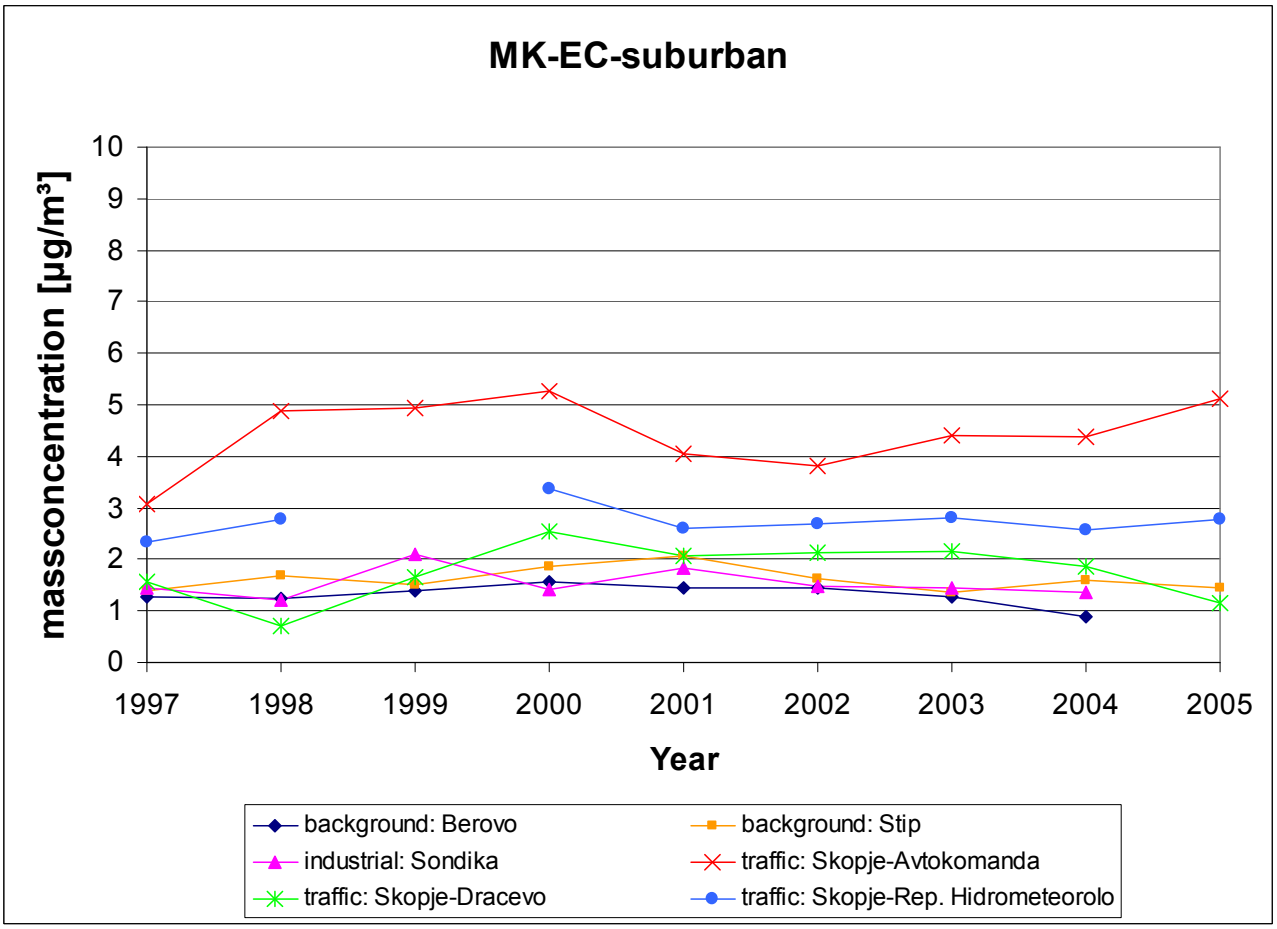

IR-EC-suburban-rural
masconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1973
1976
1979
1982
1985
1988
1991
1994
Year
Rural-background: Aghada
Suburban-background: Fingl
Suburban-traffic: Rathmi

Macedonia

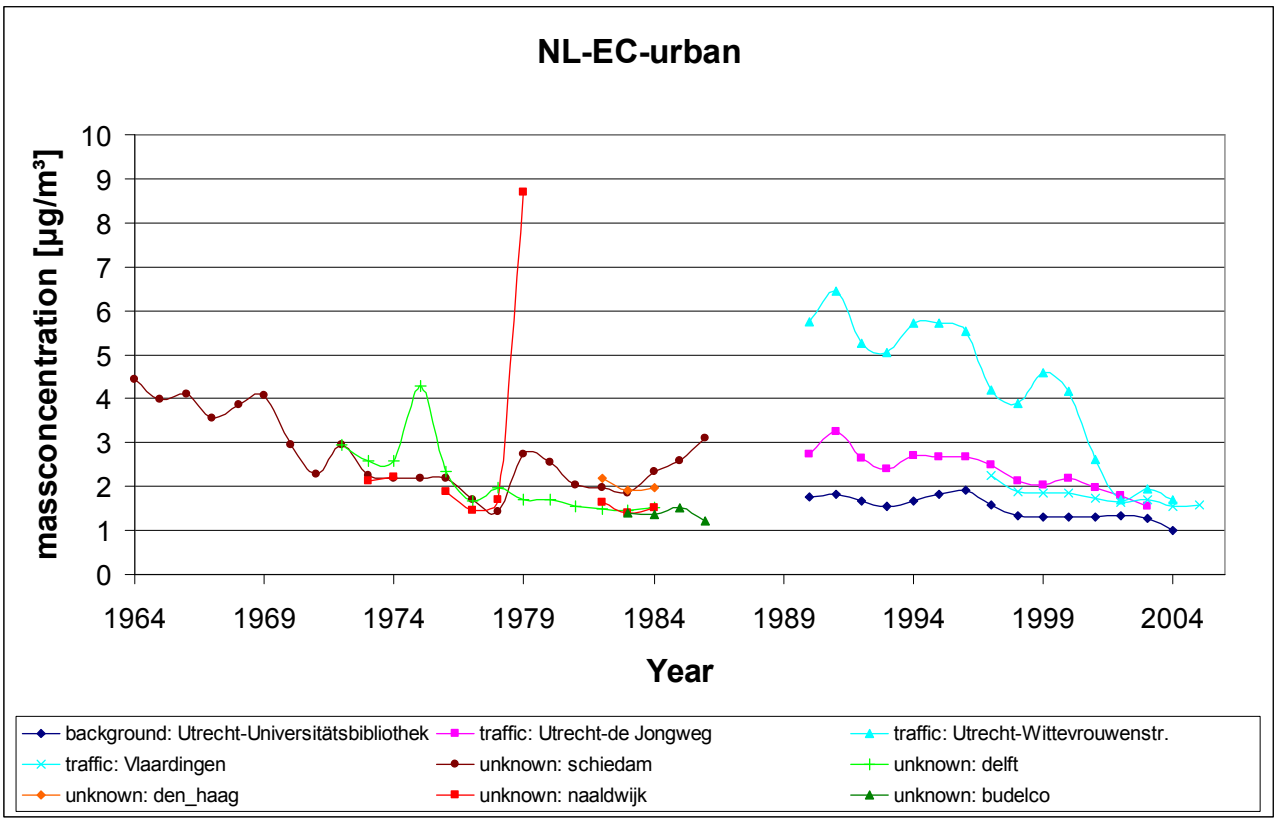

MK-BC-urban-background
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
Gevgelija
Ohrid
Prilep
Skopje-Basic school
Skopje-Brewery
Skopje-Cement industry
Skopje-DDD
Skopje-Hotel Panorama
Skopje-Kindergarden
Skopje-Public Health Institut
Veles
Veles-Employment Office

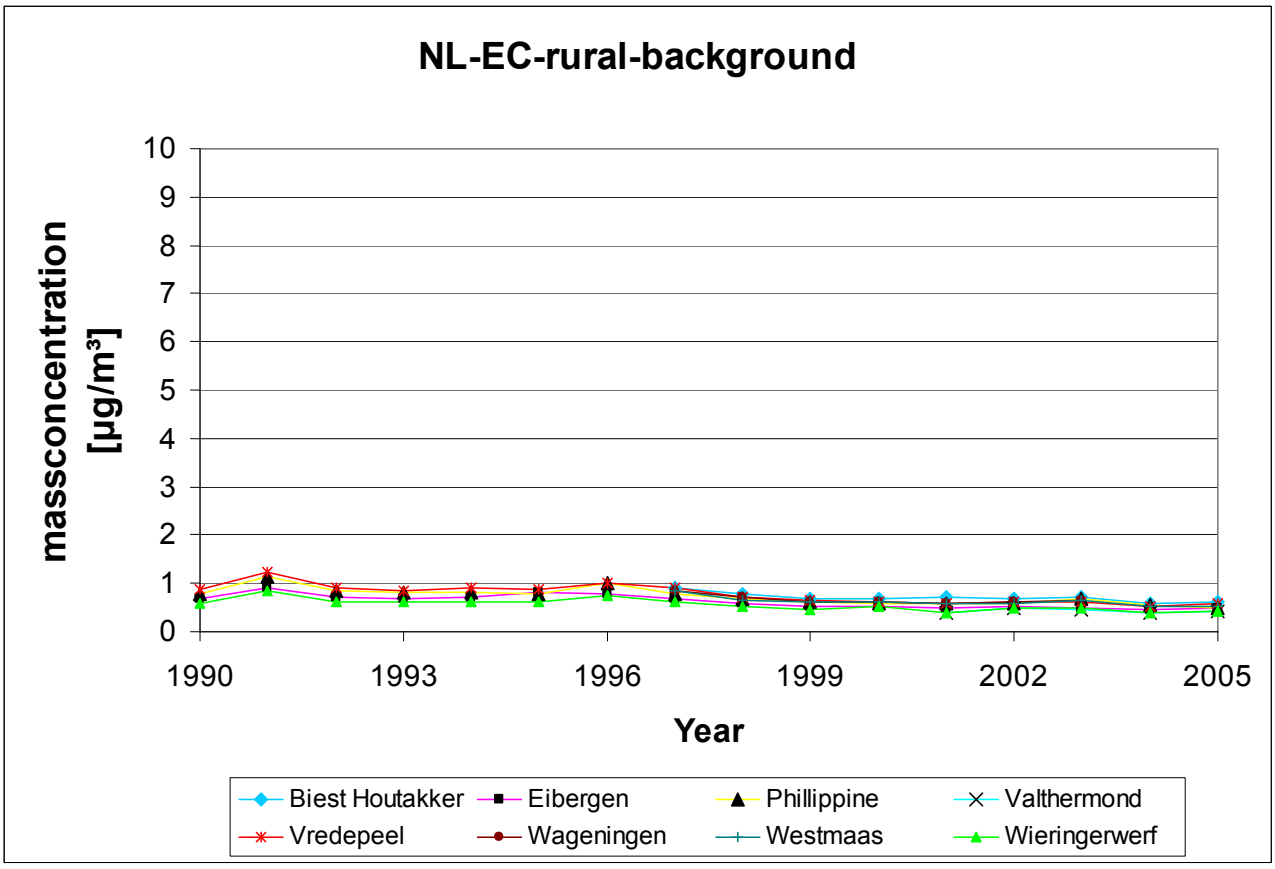

MK-EC-urban-industrial/traffic
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year
Industrial: Skopje-Fruit Farming Institute
Industrial: Veles
Traffic: Skopje-Karpos
Traffic: Skopje-University
Traffic: Skopje-AMSM
Traffic: Skopje-Novo Lisice
Traffic: Veles


MK-EC-urban-industrial/traffic
massconcentration [µg/m³]
Year
Industrial: Skopje-Fruit Farming Institute
Industrial: Veles
Traffic: Skopje-Karpos
Traffic: Skopje-University
Traffic: Skopje-AMSM
Traffic: Skopje-Novo Lisice
Traffic: Veles

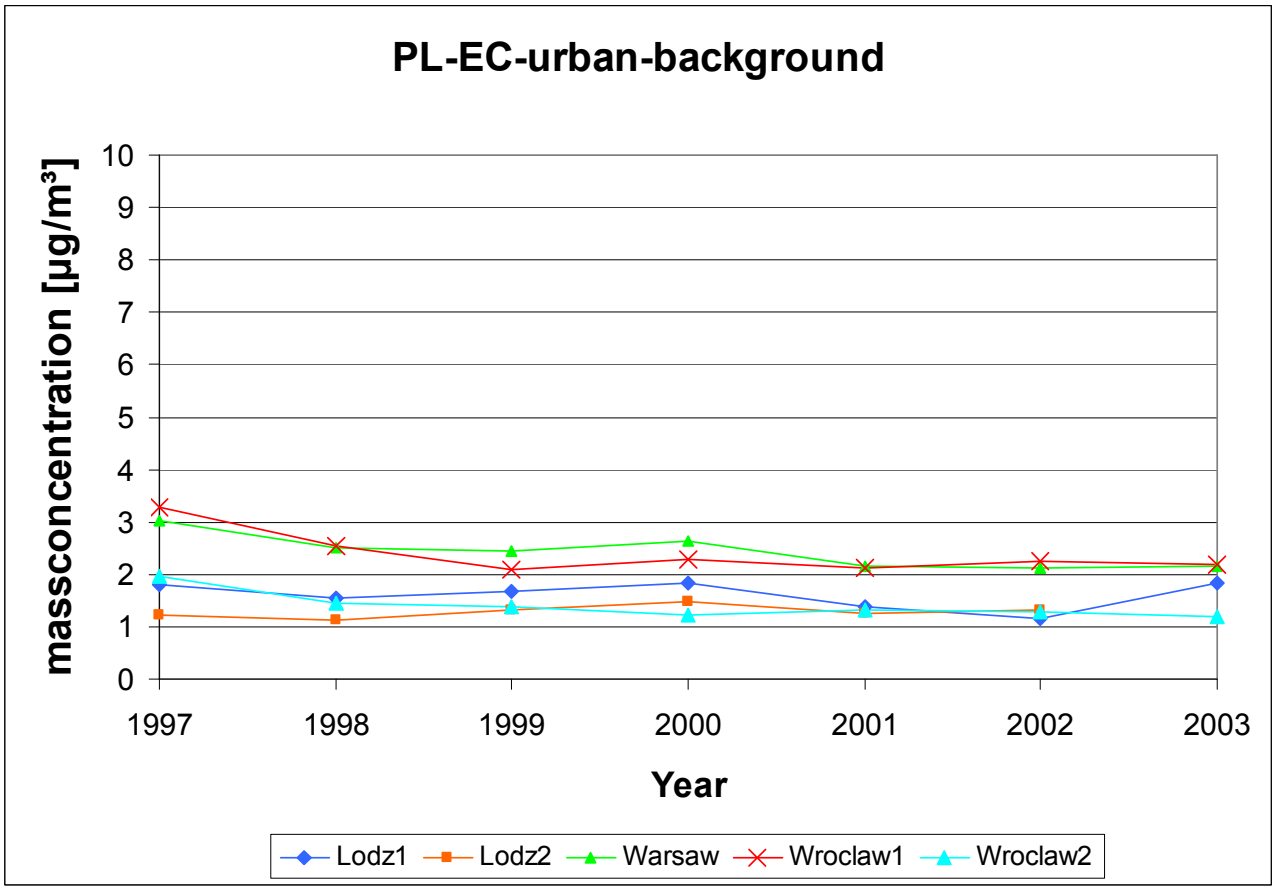

MK-EC-suburban
massconcentration [µg/m³]
Year
background: Berovo
background: Stip
industrial: Sondika
traffic: Skopje-Avtokomanda
traffic: Skopje-Dracevo
traffic: Skopje-Rep. Hidrometeorolo

Netherlands

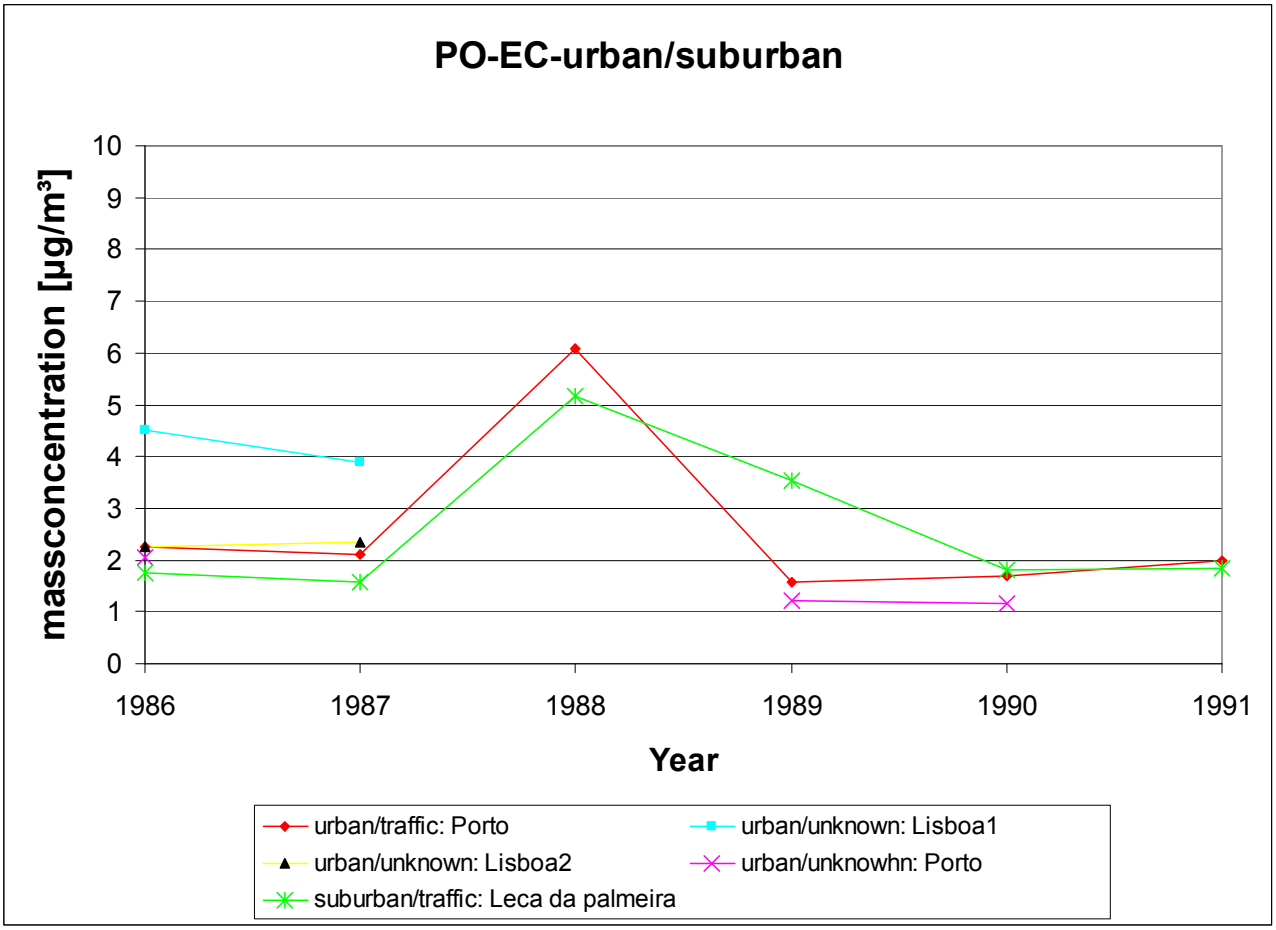




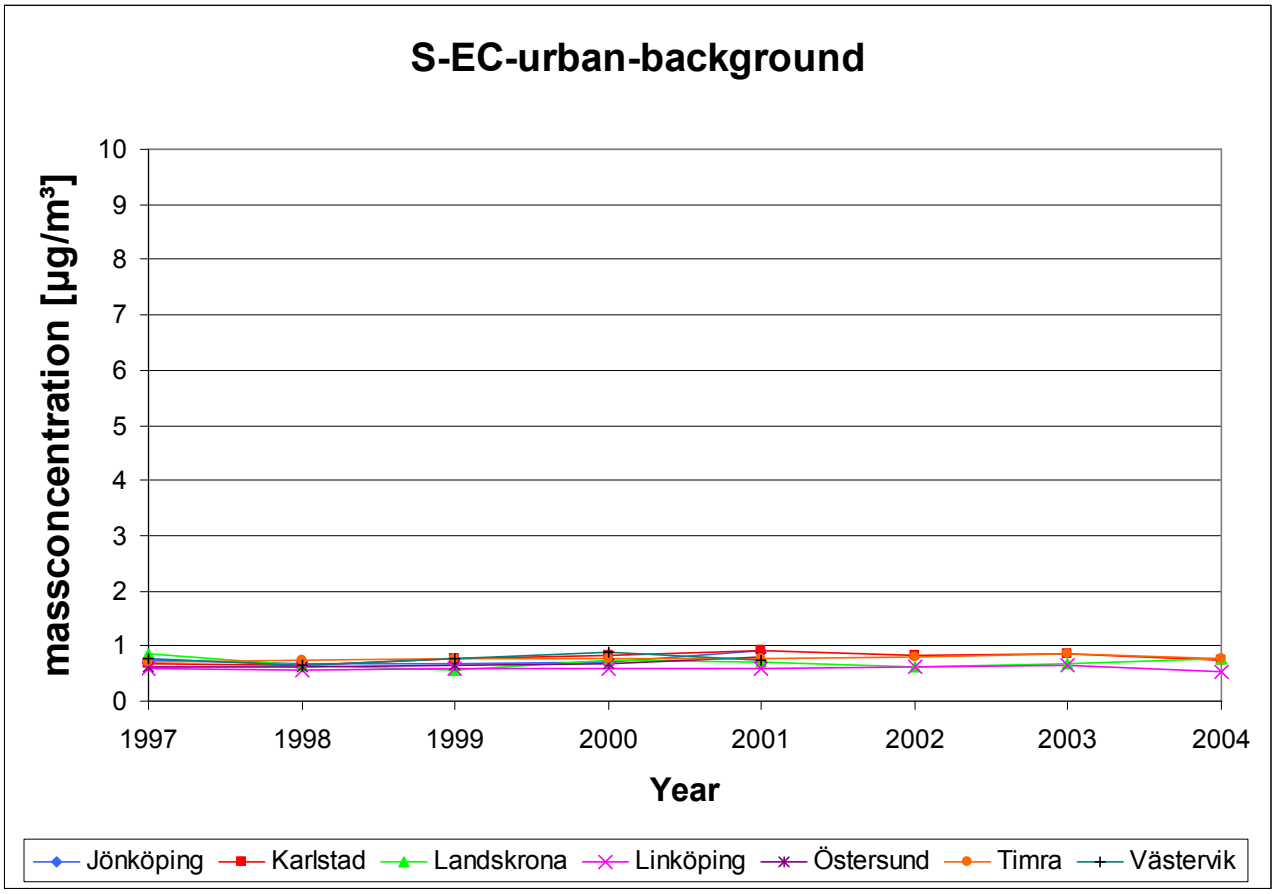
Poland

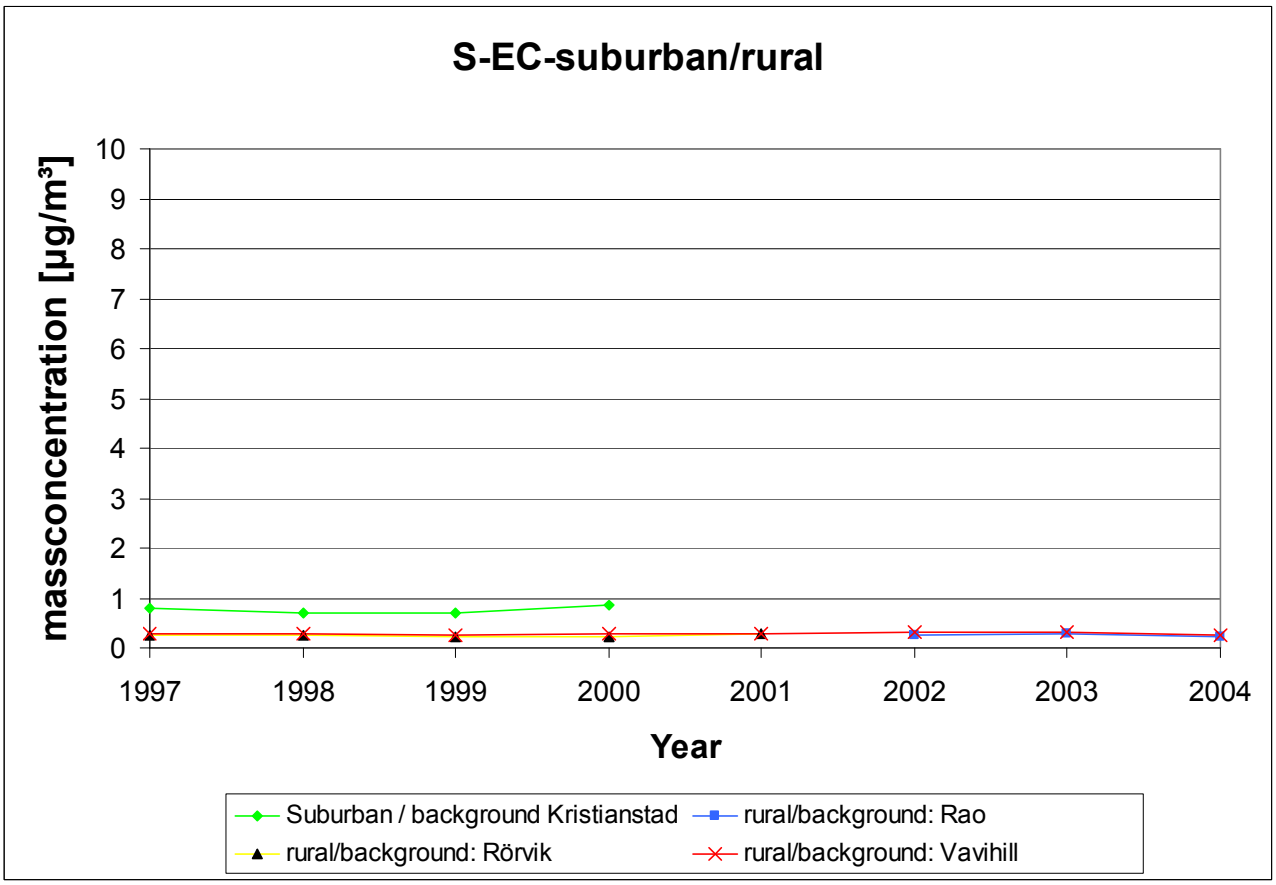

PL-EC-urban-background
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1997
1998
1999
2000
2001
2002
2003
Year
Lodz1
Lodz2
Warsaw
Wroclaw1
Wroclaw2

Portugal

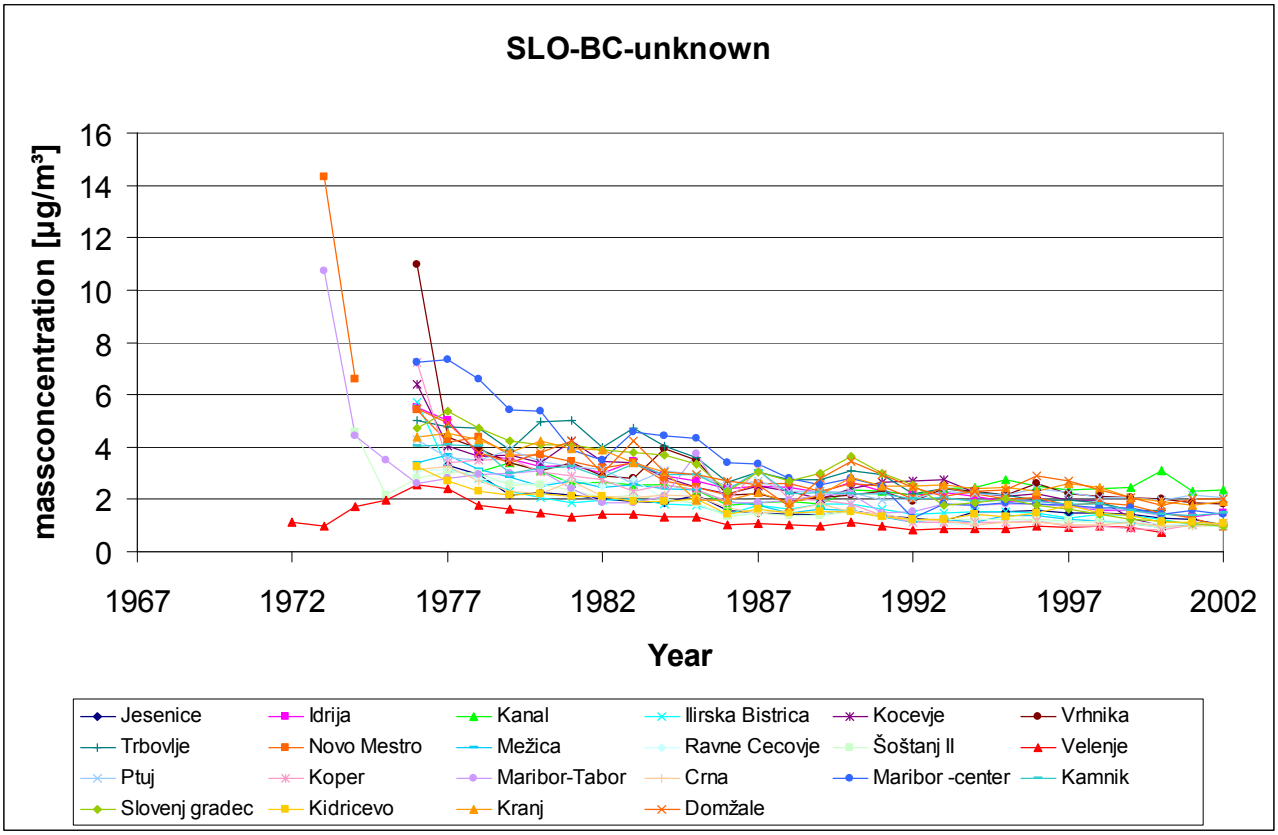

PO-EC-urban/suburban
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1986
1987
1988
1989
1990
1991
Year
urban/traffic: Porto
urban/unknown: Lisboa1
urban/unknown: Lisboa2
urban/unknowhn: Porto
suburban/traffic: Leca da palmeira

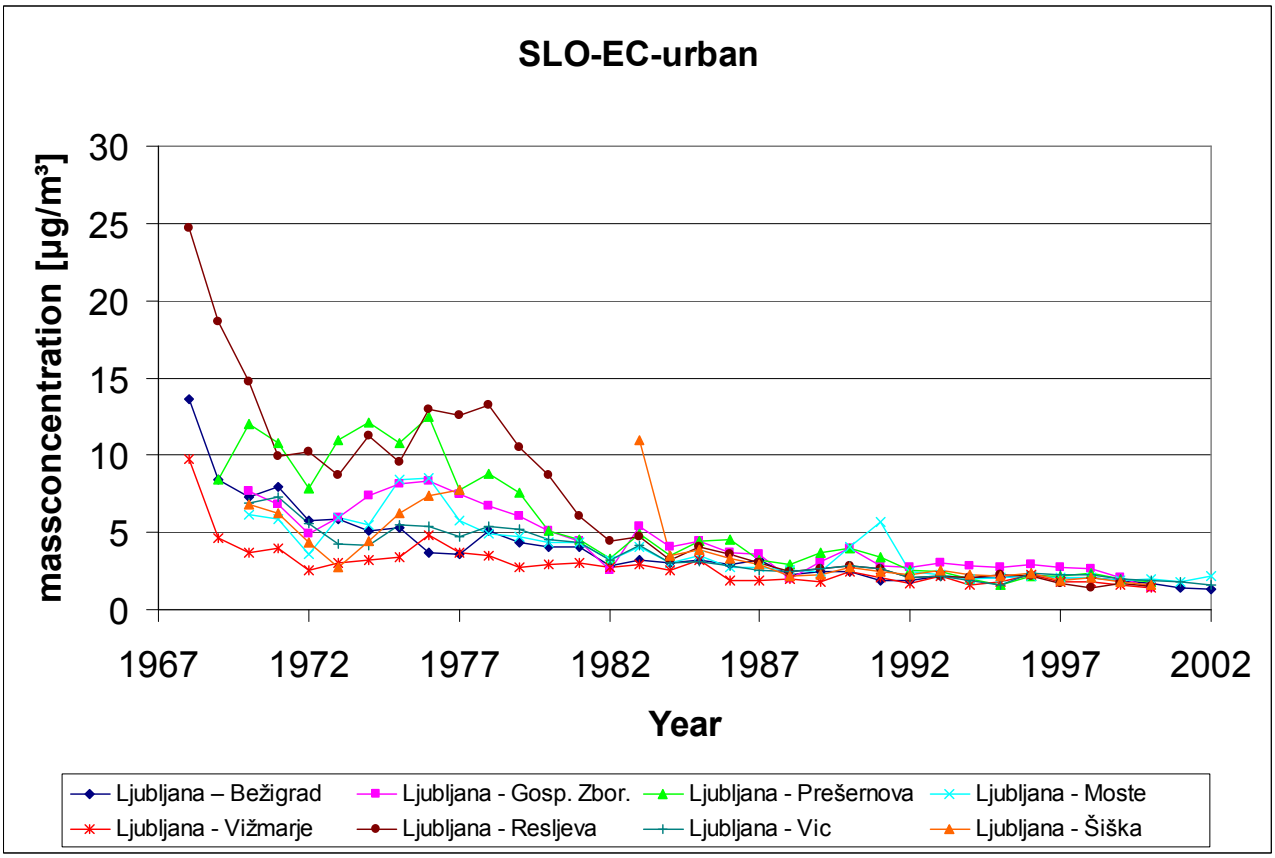
Sweden


S-EC-urban-background
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1997
1998
1999
2000
2001
2002
2003
2004
Year
Jönköping
Karlstad
Landskrona
Linköping
Östersund
Timra
Västervik


S-EC-suburban/rural
massconcentration [µg/m³]
10
9
8
7
6
5
4
3
2
1
0
1997
1998
1999
2000
2001
2002
2003
2004
Year
Suburban / background Kristianstad
rural/background: Rao
rural/background: Rörvik
rural/background: Vavihill

Slovenia


SLO-BC-unknown
massconcentration [µg/m³]
16
14
12
10
8
6
4
2
0
1967
1972
1977
1982
1987
1992
1997
2002
Year
Jesenice
Idrija
Kanal
Ilirska Bistrica
Kocevje
Vrhnika
Trbovlje
Novo Mestro
Mežica
Ravne Cecovje
Šoštanj II
Velenje
Ptuj
Koper
Maribor-Tabor
Crna
Maribor -center
Kamnik
Slovenj gradec
Kidricevo
Kranj
Domžale


SLO-EC-urban
massconcentration [µg/m³]
30
25
20
15
10
5
0
1967
1972
1977
1982
1987
1992
1997
2002
Year
Ljubljana – Bežigrad
Ljubljana - Gosp. Zbor.
Ljubljana - Prešernova
Ljubljana - Moste
Ljubljana - Vižmarje
Ljubljana - Resljeva
Ljubljana - Vic
Ljubljana - Šiška

Part C) Inventory on recent and on-going European projects on outdoor air PM and health (WG2)

Inventory on recent and on-going European projects on outdoor air PM and health (WG2).

Project name (acronym if available)	Co-ordinating scientist and institute	Funding period	Key words	Website
Multinational EU-projects				
Short-term effects of Air Pollution on Health: a European Approach to methodology, dose response assessment and evaluation of public health significance (APHEA 1 & 2)	Klea Katsouyanni , University of Athens Medical School, Department of Hygiene and Epidemiology, Athens, GR	1991-2005	Epidemiology, mortality, hospital admissions	
Risk assessment of exposure to traffic-related air pollution for the development of inhalant allergy, asthma and other chronic respiratory conditions in children (TRAPCA)	Bert Brunekreef Wageningen Agricultural University NL/UU	1998-2000	Epidemiology	
Exposure and risk assessment for fine and ultrafine particles in ambient air (ULTRA1 & 2)	Juha Pekkanen, National Public Health Institute (KTL), Department of Environmental Health, Kuopio, FI	1996-2000	Epidemiology, exposure, chemical and source characterization	http://www.ktl.fi/ultra
Relationship between Ultrafine and fine Particulate matter in Indoor and Outdoor air and respiratory Health (RUPIOH)	Gerard Hoek, University of Utrecht, Institute for Risk Assessment Sciences, NL	2002-2005	Exposure, epidemiology	http://www.iras.uu.nl/
Air pollution and inflammatory response in myocardial infarction survivors: gene-environment-interactions in a high-risk group (AIRGENE)	Annette Peters, GSF National Research Center for Environment and Health, Institute of Epidemiology, DE	2003-2005	Epidemiology, biomarkers	http://www.gsf.de/epi/en/ag_epi_luftsch_1.html#airgene
Health Effects of Air Pollution on Susceptible Subpopulations – traditional air pollutants, ultrafine particles and myocardial infarction (HEAPSS)	Francesco Forastiere, Department of Epidemiology, Rome E Local Health Authority, Rome, IT	2001-2003	Epidemiology	http://www.epiroma.it/heapss/
Prevalence and Determinants of Childhood Asthma and Allergies across Europe (ISAAC II / PDCAAE)??	Stephan Weiland?? Abteilung für Epidemiologie Universität Ulm, DE	2000-2005	Epidemiology	
Air Pollution Exposure Distributions of Adult Urban Populations in Europe (EXPOLIS)	Matti Jantunen, National Public Health Institute (KTL), Kuopio, FI	1996-2004	Health, exposure	http://www.ktl.fi/expolis/
Historic Data of Ambient Air Pollution in 37 European Cities of European Community Respiratory Health Survey (ECRHS I and II)	Peter Burney Kings Collegue London, Dept. Public Health Science, London, UK	1990-2002	Exposure, epidemiology	

Assessment and Prevention of acute Health Effects and Weather conditions in Europe (PHEWE)	Paola Michelozzi Department of Epidemiology, Health Authority RM/E, Rome, Italy	2002-2005	Exposure, modelling	
Biomarkers of genotoxicity of urban air pollution: A dose-response study (AULIS)	Soterios A. Kyrtopoulos, Institute of Biological Research and Biotechnology, National Hellenic Research Foundation, Athens, GR	1994-1998	Human biomarkers	http://www.eie.gr/institutes/ibeb/programs/aulis.htm
APHEIS: Health impact assessment of long-term exposure to $PM_{2.5}$ in 23 European cities	Sylvia Medina, Department of Environmental Health, National Institute of Public Health, InVS, 12 rue du Val d'Osne, Saint Maurice Cedex, France	1999-2000	Long-term exposure, PM2.5, mortality	www.apheis.net
Biomarkers for non-invasive assessment of respiratory effects of air pollution in children and adults along a North-South European gradient (HELIOS).	Alfred Bernard, Catholic University of Louvain, Unit of Industrial Toxicology and Occupational Medicine, Brussels, BE	2000-2002		
Effects of polycyclic aromatic hydrocarbons (PAHs) in environmental pollution on exogenous and endogenous DNA damage (EXPAH)	Peter B Farmer Cancer Biomarkers and Prevention Group, Leicester, UK	2001-2003		http://www.le.ac.uk/biochem/pbf1/EXPAH.html
Health effects of particles from motor engine exhaust and ambient pollution – A European collaborative project (HEPMEAP)	Thomas Sandström, Department of Respiratory Medicine and Allergy, Umeå University Hospital, Umeå, SE	2001-2004	Cell and animal toxicology, chemical and source characterization	http://www.hepmeap.org
Respiratory allergy and inflammation due to ambient particles – a European-wide assessment (RAIAP)	Erik Dybing, Norwegian Institute of Public Health, Oslo, NO	2000-2004	Cell and animal toxicology, chemical characterization	http://www.raiap.org/
Chemical and biological characterisation of ambient air coarse, fine and ultrafine particles for human health risk assessment in Europe (PAMCHAR)	Raimo O. Salonen, National Public Health Institute (KTL)	2002-2007	Cell and animal toxicology, chemical and source characterization	http://www.pamchar.org/
Multidisciplinary approach to airborne pollutant health related issues: modelization with combustion engine exhausts (MAAPHRI)	Jean-Paul Morin, INSERM, the French Institute of Health and Medical research, Laboratory, Rouen, FR	2002-2005	Toxicology	http://www.lille.inserm.fr/index_maaphri.html
Population Exposure to Air Pollutants in Europe (PEOPLE)	EC/DG-Research Joint Reseaarch Centre, Ispra, Italy	2002-2005	Exposure	http://ies.jrc.cec.eu.int/97.html

Austria				
Austrian project on health effects of particulates (AUPHEP)	Helger Hauck, Austrian Academy for Sciences, Clean Air Commission, Austria	1999 – 2006 (follow ups)	Epidemiology, time series	http://www.oeaw.ac.at/krl/projekte/abgeschl/auphep/auphep_en.htm
Belgium				
Peripheral markers for risk assessment of nephrotoxic and pneumotoxic pollutants: mechanistic basis and health significance of intermediate endpoints (PNEUMO-NEPHROTOX)	Alfred Bernard, Catholic University of Louvain, Unit of Industrial Toxicology and Occupational Medicine, Brussels, BE	1996 - 1999	Human biomarkers	
Toxicity of airborne pollutant particles - in vitro studies	Greet Schoeters VITO, Flemish institute for technological research, ?, BE	1998-2004	Cell toxicology	
Czech Republic				
Impact of Air Pollution on Human Health (TEPLICE PHARE II, EC/HEA-18-CZ/ Teplice	Radim J Sram, Laboratory of Genetic Ecotoxicology Regional Institute of Hygiene of Central Bohemia & Institute of Experimental Medicine ASCR Prague , CZ		Epidemiology, toxicology	
Denmark				
Biomarkers and Air samplers for Assessment of Exposure and Effects of Urban Air Pollution (BIOAIRPEX)	Steffen Loft, University of Copenhagen, Institute of Public Health, Copenhagen, DK	1999-2003	Human biomarkers, exposure	
Health Effects of Air Pollution and Diet – Interactions in Oxidative Stress (HEAPOD)	Steffen Loft, University of Copenhagen, Institute of Public Health, Copenhagen, DK	1999-2003	Human biomarkers	
Health Outcomes and Traffic Generated Air Pollution - HOTGAP	Lis Keiding, National Institute of Public Health (NIPH), Copenhagen, DK	2001-2004		

Air Pollution in a Life Time Health Perspective (AIRPOLIFE)	Steffen Loft, University of Copenhagen, Institute of Public Health, Copenhagen, DK	2004-2008	Epidemiology, exposure, human biomarkers, cell and animal toxicology, modelling	www.airpolife.ku.dk
Exposure to air pollution and risk for lung cancer (CEMIK)	Ole Raaschou-Nielsen, Danish Cancer Society, Copenhagen, DK	2000-2004	Epidemiology, exposure	
Health effects of air pollution – subproject under Centre for Transport Research on environmental and health Impacts and Policy (TRIP3), National Environmental Research Programme	Ole Hertel, National Environmental Research Institute, Roskilde, DK	2000-2004	Exposure, ?	www.akf.dk/trip
Traffic Air Pollution Exposure Modelling	Steen Solvang Jensen, National Environmental Research Institute, Department of Atmospheric Environment, Roskilde, DK	2000-2003	Exposure	http://www.akf.dk/trip/
Air pollution with fine particles in Denmark (AIDA)	Finn Palmgren Jensen, National Environmental Research Institute, Roskilde, DK	2001-2007	Exposure, modelling	http://www2.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR460.PDF
Finland				
Seasonal variations in physicochemical and toxicological characteristics of urban air particulate matter (PAMCHAR-FINE)	Raimo O Salonen, National Public Health Institute (KTL), Department of Environmental Health, Kuopio, FI	2003-2007	Cell toxicology, chemical and source characterization	
Health effects caused by urban air pollution for the transport system plan scenarios in Helsinki Area – HEAT	Juha Pekkanen, National Public Health Institute (KTL), Department of Environmental Health, Kuopio, FI	2002-2004	Exposure, risk assessment	http://www.fmi.fi/research_air/air_18.html
An integrated model for evaluating the emissions, atmospheric dispersion and risks caused by ambient air fine particulate matter (KOPRA)	Jaakko Kukkonen, Finnish Meteorological Institute, Helsinki, FI	2002-2005	Exposure, risk assessment	http://www.ymparisto.fi/default.asp?contentid=69595&lan=EN
Inflammation and fine particulate air pollution	Iiris Salonen, Kymenlaakso Central Hospital, Kotka, FI, Raimo O. Salonen, National Public Health Institute, Kuopio, FI, and Risto Hillamo, Finnish Meteorological Institute, Helsinki, FI	2004-2007	Epidemiology, particulate characterization, personal exposure, toxicology	

France				
The French Six Cities Study	Isabella Annesi-Maesano INSERM, the French Institute of Health and Medical Research, Laboratory of Epidemiology and Biostatistics, FR	1999-2001	Epidemiology	
Study on Outdoor Environmental Factors related to Cardiorespiratory Admissions in Intensive Care Units (REAPOL)	Claire Segala, SEPIA (Societ d'epidemiologie et d'analyse)	2002-2003	Epidemiology	
Study of the impact of environmental factors and individual susceptibility factors on respiratory admissions in intensive care units	Claire Segala, SEPIA (Societ d'epidemiologie et d'analyse)	2002-2005	Epidemiology	
Winter air pollution and infant bronchiolitis in Paris	Claire Segala, SEPIA (Societ d'epidemiologie et d'analyse)	2002-2003	Epidemiology	
Cellular and molecular mechanisms involved in the induction of respiratory diseases by fine atmospheric particles.	Francelyne Marano, Laboratoire de Cytophysiologie et toxicologie cellulaire, Université Paris 7, Paris, FR	2002-2005	Cell toxicology, particle characterisation	
Physico-chemical characterization and biologic effects of the background atmospheric fine and ultrafine particles	Armelle Baeza, Laboratory of Cytophysiology and Cellular respiratory, University Paris 7 and Laurent Martinon, laboratory of inhalated particles, Paris	2004-2006	Cell toxicology, particle characterisation	
Impact of complex aerosols containing nanoparticulate matter inhalation on heart, kidney and reproductive functions in healthy and chronic cardiac insufficient rodents	Jean-Paul Morin, INSERM, the French Institute of Health and Medical research, Laboratory, Rouen	2004-2006	Toxicology	
TOPAASE : integrated program aiming at gathering transdisciplinary experiences and actors in the field of airborne pollutant metrology, toxicology assessment, local dispersion, modelization, exposure assessment and health impact evaluation.to tackle airborne pollutant related issues	Jean-Paul Morin, INSERM, the French Institute of Health and Medical research, Laboratory and Frédéric Dionnet,CERTAM, Rouen			
Formation, ageing process, analysis and toxicity of secondary organic particles	Benedicte Picquet-Varault, , LISA (laboratory of atmospheric systems) universite Paris 7 et 12	2004-2006	Particle characterisation, modelling and toxicology	

Germany				
Bitterfeld Study	H.-Erich Wichmann GSF, National Research Center for Environment and Health, Institute of Epidemiology, Neuherberg / Munich, DE	1998-99		
Activity of particulate matter sampled in Hettstedt-Zerbst	Joachim Heinrich GSF, National Research Center for Environment and Health, Institute of Epidemiology, Neuherberg / Munich, DE	2001-2003		
Airborne Dust in Germany and Argentina and children's health - Comparison of Argentinien and German Circumstances (AGAD)	Olf Herbarth UFZ - Centre for Environmental Research Ltd., Department of Human Exposure and Epidemiology, Leipzig – Halle, DE	2002-2004		
Diesel Study - Traffic-related outdoor and indoor concentrations of fine particles in Erfurt, Germany (UBA	H.-Erich Wichmann GSF, National Research Center for Environment and Health, Institute of Epidemiology, Neuherberg / Munich, DE	2000 - 2003		http://www.gsf.de/epi/de/index_veranst.html
Longitudinal Panel Study for Investigation of Acute Pulmonary, Cardiac and Hematologic/ Hemostaseologic Effects of Fine Particles in Real Environmental Conditions (CorPuScula)	Dr. Peter Höppe Ludwig Maximillians Universty, Institute for Occupational and Environmental Medicine, Munich, DE	1999-2002		http://arbmed.klinikum.uni-muenchen.de/
Cardiovascular effects of fine and ultrafine particles	Paul J.A. Borm Institut für Umweltmedizinische Forschung gGmbH (IUF), Particle Research Core, Düsseldorf, DE	2001-2004	Cell and animal toxicology	
Oxidant activity as an alternative metric for activity of ambient PM	Paul J.A. Borm Institut für Umweltmedizinische Forschung gGmbH (IUF), Particle Research Core, Düsseldorf, DE		Cell toxicology	
Particles in the developing lung: a bioengineering approach	Dr. Wolfgang Kreyling, GSF-Research Centre for Environment + Health, Inst. For Inhalation Biology, NIH-grant together with	2003-2008	Particle deposition in the developing lungs	

	Harvard School of Public Health, Boston, USA			
In vivo toxicity of ultrafine particles	Prof. Dr. Holger Schulz, GSF-Research Centre for Environment + Health, Inst. For Inhalation Biology	2002-	Carbonaceous ultrafine particles, inhalation studies, inflammatory responses, animal models of susceptibility	http://www0.gsf.de/ihb
In vitro toxicity of ultrafine particles	Dr. Konrad Maier, GSF-Research Centre for Environment + Health, Inst. For Inhalation Biology	2002-	Carbonaceous ultrafine particles, cell exposures, inflammatory responses, primary cells + cell lines	http://www0.gsf.de/ihb
Dosimetry of ultrafine particles and nanoparticles after inhalation and other routes of administration	Dr. Wolfgang Kreyling, GSF-Research Centre for Environment + Health, Inst. For Inhalation Biology	2002-	Dosimetry (deposition, clearance, translocation to secondary target organs) of ultrafine metal-containing + carbonaceous particles, inhalation studies	http://www0.gsf.de/ihb
Health effects of ambient aerosol particles	Dr. Wolfgang Kreyling, GSF-Research Centre for Environment + Health, Focus Network: Aerosols + Health	2002-	PM characterization, exposure, dosimetry, toxicology + epidemiology, health effects + risk assessment	http://www0.gsf.de/aerosols
Ireland				
Linking urban and harbour air field measurements of particulate matter to their chemical analysis and effects on health (Ireland)	Professor John Sodeau. University College Cork	2004-2010	Toxicology; Physico-chemical analysis; chemometrics	http://crac.ucc.ie
Netherlands				
Epidemiologic study health effects air pollution	Paul Fischer National Institute of Public Health and the Environment (RIVM), Bilthoven, NL	2000-2004		
Exposure and health effects modeling of acidification and PM pollution in urban and regional areas	Jeannette Bek National Institute of Public Health and the Environment (RIVM), Bilthoven, NL	2002-2004		http://www.rivm.nl/

Health effects of Air Pollution: application of gene-expression profiling in compromised animals	Flemming R Cassee National Institute of Public Health and the Environment (RIVM), Bilthoven, NL		Animal toxicology	
Norway				
Air pollution and cardiopulmonary diseases in a cohort of Norwegian men (1972/73 to 1998)	Per Nafstad Norwegian Institute of Public Health, Division of Epidemiology, Oslo, NO		Epidemiology	
Air pollution and asthma and allergy among school children in Oslo	Per Nafstad Norwegian Institute of Public Health, Division of Epidemiology, Oslo, NO	2003-2006	Epidemiology	
Environment and Childhood Asthma study in Oslo (ECAO)	Karin C. Lødrup Carlsen, Ullevål University Hospital, ?, NO	2000-2007	Epidemiology	www.barneastmastudien.no
Particle-induced stress responses in lung and heart: Significance of ultrafine particles and metals	Marit Låg, Norwegian Institute of Public Health, Division of Environmental Medicine, Oslo, NO	2004-2007	Cell and animal toxicology?	http://www.fhi.no/eway/
Mechanisms for cytokine responses and cytotoxicity induced by mineral particles in epithelial lung cells	Magne Refsnes, Norwegian Institute of Public Health, Division of Environmental Medicine, Oslo, NO		Cell toxicology	
Importance of particulate matter for the development of chronic lung disease. Use of cell cultures for identification of early fibrotic changes in the lung	Per E. Schwarze, Norwegian Institute of Public Health, Division of Environmental Medicine, Oslo, NO	2003-2007	Cell toxicology	
Mechanisms involved in and the role of PAH-induced apoptosis and inflammation for cancer related particular matter	Jørn A. Holme, Norwegian Institute of Public Health, Division of Environmental Medicine, Oslo, NO	2001-2007	Cell toxicology	
Allergic and inflammatory effects of particular matter from various sources	Martineus Løvik, Norwegian Institute of Public Health, Division of Environmental Medicine, Oslo, NO	2002-2007	Cell and in animal models	

Poland				
Vulnerability of the Fetus/Infant to PAH, PM2,5 and ETS	Wiesław Jędrychowski, Department of Epidemiology and Preventive Medicine, Jagiellonian University, Cracow, Poland, Columbia Center for Children's Environmental Health, Joseph L. Mailman School of Public Health	on-going	Postnatal exposure, environmental pollution, cohort study	www.clinicaltrialssearch.org
Relationship between daily mortality and daily concentration of ambient air pollution in population living in Katowice Agglomeration, in the period 2001-2002 and 1994-2005.	Jan E. Zejda, Department of Epidemiology, Medical University of Silesia, Katowice, Poland	2004-2006	Environmental epidemiology	www.osf.opi.org.pl
Identification of factors influencing chemical composition and concentration levels of chosen fractions of atmospheric aerosols and an assessment of health aspects in people inhabiting urban industrial areas associated with exposure to these agents.	Leszek Ośródka, Institute of Meteorology and Water Management, Cracow, Poland Medical University of Silesia, Katowice, Poland, Institute of Environmental Engieneering, Zabrze	2006-2008	Particulate matter, meteorology, epidemiology, emissions inventories, chemical and physical properties of PM, health risk analysis, forecast air pollution, data mining	www.osf.opi.org.pl
Project Multiyear: Environmental and Health - Polish Environmental Health Action Plan	Janina Fudala Institute for Ecology of Industrial Areas in Katowice; Institute of Occupational Medicine and Environmental Health in Sosnowiec; Central Mining Institute in Katowice; Institute of Environmental Engineering, Zabrze, Poland	2000 – on-going	quality of life, environmental health, particle sources, chemical, physical, biological properties	www.wpr.imp.sosnowiec.pl
From toxic emissions to health effects. An integrated emissions, air quality and health impacts case study in Cracow, Poland.	Jose M.Jimenez, Ispra	2004-2006		www.krakow.pios.gov.pl
Portugal				
Health and the Air we breathe (SAUDAR)	Carlos Borrego, University of Aveiro, Aveiro, Portugal	2004-2008	Exposure, characterization of outdoor and indoor particles	www.dao.ua.pt/gemac/saudar
Air Quality and Human Health	Conceição Alvim Ferraz, University of Porto, Porto, Portugal		Exposure, particulate characterization	

Air Quality Study in Lisbon	Francisco Ferreira, New University of Lisbon, Lisbon, Portugal		Exposure, outdoor and indoor particles, daily activity	
PAREXPO - Particulate Matter in Ambient Air and Human Exposure	Carlos Borrego, University of Aveiro, Aveiro, Portugal	12/2005 – 11/2008	Exposure, characterization of outdoor and indoor particles	

Spain				
Spanish Multi-centre Study on Air Pollution and Health (EMECAS)	Ferran Ballester, Epidemiology and Statistics Unit, Escuela Valenciana de Estudios para la Salud, Valencia, S	1997-2002	Epidemiology	
REGICOR2000-Air (Cardiovascular health and air pollution)	Nino Kuenzli, CREAL at IMIM; Jaume Marrugat IMIM, Barcelona, Spain	2007-2009	Epidemiology, exposure	
Sweden				
Associations between air pollution from wood heating and risk factors for cardio-vascular disease?	Bengt Järvholm Occupational and Environmental Medicine, Public Health and Clinical Medicine, Umeå University, Umeå, SE	2001-2003		
A method for determination of personal 1,3-butadien exposure	Lars Barregard, University of Gothenburg, , Gothenburg, SE	2001-2005	Exposure	http://www.SNAP.se
Personal exposure to fine particles, PM2.5 in the general population	Gerd Sällsten, University of Gothenburg, Gothenburg, SE	2001-2005	Exposure	http://www.SNAP.se
Exposure to air pollutants at domestic wood burning	Lars Barregard, University of Gothenburg, Gothenburg, SE	2001-2005	Toxicology, exposure, biomarkers	http://www.SNAP.se
Acute effects of wood particles – an experimental study of real life exposure	Lars Barregard, University of Gothenburg, Gothenburg, SE	2003-2006	Toxicology, exposure, biomarkers	http://www.SNAP.se
BHM (Biofuels) Programme – Health Effects Cluster	Bertil Forsberg, Umeå University, Department of Public Health and Clinical Medicine, Umeå, SE	2002-2004/5	Epidemiology	www.itm.su.se/BHM/index.html
Interactions between particles and ozone (INTERPOZ)	Bertil Forsberg, Umeå University, Department of Public Health and Clinical Medicine, Umeå, SE	2004-2006	Epidemiology	www.friskluft.se
Traffic related particles: relative and absolute impact on quantificable health endpoints	Bertil Forsberg, Umeå University, Department of Public Health and	2005-2007	Epidemiology	www.friskluft.se

(TRAPART)	Clinical Medicine, Umeå, SE			
Exposure and dose-response calculations of particulate matter in Stockholm - number, surface area and mass concentrations (PASTA)	Christer Johansson, Stockholm University, Institute of Applied Environmental Research, Stockholm, SE	2001-2004	Exposure	
Effects of outdoor and indoor air pollution on the development of allergic disease in children (AIRALLERG)	Tom Bellander, Stockholm County Council, Department of Occupational and Environmental Health, Stockholm, SE	2002-2006		http://www.snap.se/Projekt/inneute.htm
Switzerland				
Swiss Study on Air Pollution and Lung Disease in Adults (SAPALDIA)	Philippe Leuenberger, CHUV - Centre Hospitalier Universitaire Vaudois, Lausanne, CH Ursula Ackermann-Liebrich, Institute of Social and Preventive Medicine, University of Basel, Switzerland, Basel, CH	2001-2003	Epidemiology	http://pages.unibas.ch/ispmbs/forsch/d/dpro103.htm
Swiss Cohort Study on Air Pollution and Lung Diseases in Adults (SAPALDIA 2)	Ursula Ackermann-Liebrich, Institute of Social and Preventive Medicine, University of Basel, CH Philippe Leuenberger, CHUV - Centre Hospitalier Universitaire Vaudois, Lausanne, CH	2001-2007	Epidemiology	http://www.sapaldia.ch
Swiss Cohort Study on Air Pollution and Lung and Cardiovascular Diseases in Adults (SAPALDIA 2+)	Thierry Rochat, Service de Pneumologie, Hôpitaux Universitaires de Genève, CH	2006-2009	Epidemiology	http://www.sapaldia.ch
Swiss Alpine highway supplemental air, noise, and health measurements for heavy-duty diesel trucks (MfM-U)	L.-J. Sally Liu Institute of Social and Preventive Medicine, University of Basel, CH	2007-2010	Source apportionment, exposure assessment, risk assessment, Epidemiology	http://www.ispm-unibasel.ch/english/forschung_details.php?id=98
Swiss Surveillance Program of Childhood Allergy and Respiratory Symptoms with respect to Air Pollution and Climate (SCARPOL)	Charlotte Braun-Fahrländer, Institute of Social and Preventive Medicine, University of Basel, Switzerland	1998-2004	Epidemiology	http://pages.unibas.ch/ispmbs/forsch/e/epro102.htm
Effects of airborne pollen allergens and air	Michael Riediker, Swiss Federal	1996-2000	panel study	

pollutants on allergic symptoms and lung function	Institute of Technology, CH			
United Kingdom				
Quantification of population exposure benefits of reducing roadside and urban background pollutant concentrations	Mike Ashmore, University of Bradford, Department of Environmental Science, Bradford, UK	2002-2004	Exposure, risk assessment	
Extended time series analysis of morbidity and mortality in the UK West Midlands conurbation in relation to particulate air quality metrics	Professor Ross Anderson, St George's Hospital, University of London, UK	1998-2005	Epidemiology	
The influence of air quality on events in patients fitted with implanted cardioverter defibrillators	Professor Ross Anderson, St George's Hospital, University of London, UK	2002-2007	Epidemiology	
Personal exposure to air toxics and validation by biomarker (MATCH)	Roy M. Harrison, The University of Birmingham, Birmingham, UK			http://www.gees.bham.ac.uk/research/MATCH/index.htm
Toxicity of airborne particles as a function of their size and composition	Ken Donaldson, Edinburgh University, Edinburgh, UK		Toxicology	
Links between urban and ambient particulate matter and health-particle metrics	Richard Atkinson, St George's Hospital, Medical School, London	2006-2008	Epidemiology	

APPENDIX II

Results of Action in different countries as presented at the Barcelona meeting, October 2007

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Introduction and Summary of the POLYSOA Project (Polymers in Secondary Organic Aerosols)

U. Baltensperger and the POLYSOA Consortium
Laboratory of Atmospheric Chemistry, Paul Scherrer Institut (PSI), Villigen CH-5232, Switzerland

A recent epidemiological study reveals a stronger association between daily mortality and fine particulate air pollution in summer than in winter (Nawrot et al., 2007), which suggests that secondary organic aerosol (SOA) may substantially contribute to this mortality. In addition, experiments have shown that organic material in SOA can polymerize leading to new high molecular weight compounds with mass up to 1000 Da (Kalberer et al., 2004). High molecular weight compounds have been found in ambient aerosols as well, but their origin is largely unknown and their identification rudimentary. The EC project POLYSOA (Polymers in Secondary Organic Aerosols, see http://polysoa.web.psi.ch/) was therefore initiated to provide a better characterization of these high molecular weight compounds formed in the new PSI smog chamber from photo-oxidation of biogenic or anthropogenic precursors in the presence of NOx.

A large variety of state-of-the-art analytical chemical methods were used to characterize the chemical composition of SOA particles with emphasis on the polymeric mass fraction. These well-characterized SOA particles were deposited on three lung cell culture systems (Micro-dissected epithelium from porcine trachea, a human bronchial epithelial cell line (BEAS-2B), and porcine lung surface macrophages) in a newly constructed particle deposition chamber with the goal to eventually identify particle components that are responsible for cell responses. In addition, alveolar epithelial cell lines (A549) were used in an alveolar epithelial repair model. The lung cells were examined for morphological, biochemical and physiological changes after exposure to SOA. Analyses of the lung cells after particle deposition indicate that SOA may induce distinct cellular effects. Lactate dehydrogenase release was moderately increased and the alveolar epithelial wound repair was affected mainly due to alterations of cell spreading and cell migration at the edge of the wound. Thus, first results indicate that SOA, in concentrations comparable to environmental concentrations, may induce distinct cellular effects, however, more experiments are currently performed to corroborate these effects.

Acknowledgment: The financial support by the European Commission FP6 Project POLYSOA, Contract No 12719 is gratefully acknowledged.

References

Nawrot T.S, Torfs, R., Fierens, F., De Henauw, S., Hoet, P.H., Van Kersschaever, G., De Backer, G. Nemery, B. (2007) Stronger associations between daily mortality and fine particulate air pollution in summer than in winter. Evidence from a heavily polluted region in Western Europe, *Journal of Epidemiology and Community Health*, **61**, 146-149.

Kalberer M., Paulsen D., Sax M., Steinbacher M., Dommen J., Prevot A.S.H., Fisseha R., Frankevich V., Zenobi R., Baltensperger U. (2004), Identification of polymers as major components of atmospheric organic aerosols, *Science*, **303**, 1659-1662.

PRELIMINARY RESULTS ON PM1 AND PARTICLE – BOUND POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN KOZANI, GREECE.

J.G. Bartzis[1] , S. Amarantidis[1], E. Tolis[1], D. Missia[1] , D. Saraga[2], N. Koziakis[1]

[1] University of West Macedonia Dept. of Eng.& Manag. of Energy Resources, Sialvera & Bakola Street, 50100 Kozani, Greece.
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Keywords: Polycyclic Aromatic Hydrocarbons, PM1

Introduction

During the last decade there is an increased concern on atmospheric pollution in areas suffering from major air quality problems, such as Kozani, Greece, due to the operating lignite- fire power station and their mining activities (E. Terzi et al., 2005). Recent epidemiological studies and research on the mutagenic effects of airborne particulate matter focused on the adverse health effects of fine and ultra fine particles (PM1) as they could enter deep into lungs and they are carriers of various toxic substances (R. Vecchi et al., 2004). Polycyclic Aromatic Hydrocarbons (PAHs) are widespread semi-volatile organic compounds formed during the incomplete combustion of organic material. Most of the particulate-phase PAHs (80 %) are absorbed onto fine particles (d <2.5μm).

Particulate matter and PAHs are among the pollutants of interest within the frame of COST633. This study was therefore conducted to provide information for PM1 concentrations as well as the chemical composition of the above mentioned fraction regarding polycyclic aromatic hydrocarbons (PAHs) for the city of Kozani.

Sampling and Analysis

16 EPA Polycyclic Aromatic Compounds (PAHs) associated to ambient PM1 were determined in an urban area in Kozani, Greece. Sampling was conducted for one week period on January - February 2007. Ambient PM1 were collected on PTFE filters (47mm) using low volume pumps. Each sampling session lasted 24h. The sampling site was located in the campus of University of West Macedonia (UOWM) which is approximately 0.5 Km far from city centre and about 10-12 Km away from the two lignite- fire power station operating in the area. The sampling platform was placed at the roof of the building (at a height of approximately 10 m). Determination of the PM1 concentration was performed by gravimetrical measurements. PAHs were recovered from filter samples using ultrasonic extraction with dichloromethane. Extracts were cleaned up through glass chromatography column filled with activated silica gel. The determination of PAHs was accomplished by gas chromatography coupled to a mass spectrometry detector (GC-MS).

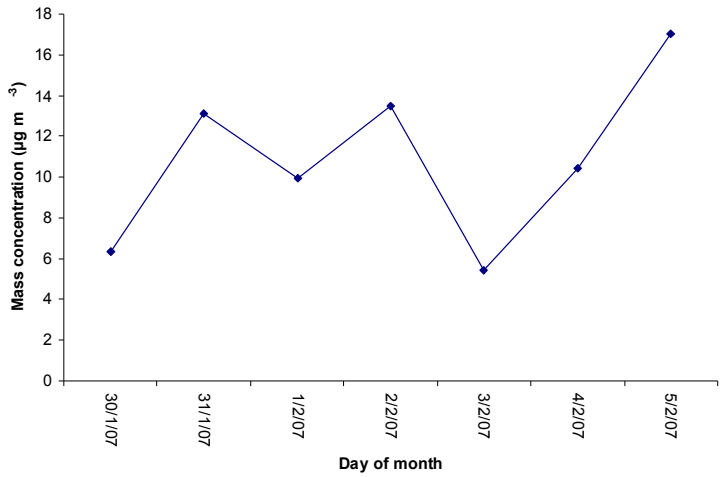

Figure 1. Daily mass concentration of PM1 measured at Kozani.

Results

The daily variation of the mass concentrations of PM1 for the city of Kozani is showed in figure 1. The daily concentration of PM1 ranged from 5.4 to 17.0 μg m^{-3}. The highest daily concentration of PM1, 17.0 μg m^{-3}, was calculated on 5 February 2007, which was the coldest day of the sampling period (2.9 ^{o}C). The mean value of

10.8 μg m^{-3} for PM1 is 4 times lower than the value of 48.0 μg m^{-3} for the city of Milan for the winter period (M. Giugliano et al., 2005).

Table 1: Mean particulate PAH concentrations in PM1 at Kozani (ng m^{-3})

		Average ±SD (range)	ΣPAHs			Average ±SD (range)	ΣPAHs
2 rings	Nap	0.015±0.017 (ND-0.050)	0.015		BaA	0.158±0.100 (0.002-0.287)	
3 rings	Ace	0.008±0.001 (ND-0.010)	0.388		Chr	0.519±0.205 (ND-0.800)	
	A	0.021±0.010 (ND-0.028)		5 rings	BaP	0.295±0.187 (0.003-0.560)	1.277
	Fl	0.016±0.004 (ND-0.021)			BbF	0.742±0.430 (0.004-1.281)	
	Phe	0.173±0.059 (0.088-0.251)			BkF	0.188±0.109 (0.001-0.319)	
	Ant	0.170±0.058 (0.084-0.250)			DA	0.052±0.030 (0.002-0.091)	
4 rings	Fla	0.353±0.123 (0.178-0.526)	1.406	6 rings	IP	0.463±0.290 (0.006-0.895)	1.100
	Pyr	0.376±0.130 (0.199-0.555)			BP	0.637±0.274 (0.366-1.109)	

The sum of 16 PAHs concentrations in PM1 was 4.18 ng m^{-3}. In Table 1 is showed the mean concentrations of the individual of the 16 PAHs. It is commonly observed that higher molecular weight PAHs are often associated with particulates while low molecular weight compounds tend to be more concentrated in the vapour phase. This trend is fulfilled in our study. Four and five-ring compounds contribute to the majority of the total PAHs, accounting for 64.1%. Indeno[1,2,3-cd]pyrene gave the maximum contribution (40.1 %) to the carcinogenic and mutagenic PAHs while dibenzo[a,h]anthracene corresponds the minimum compound to the carcinogenic spieces (4.5 %). Diagnostic PAHs ratio, such as, Flu/Flu+Pyr, and IcdP/BghiP+IcdP have been used to investigate the origin of PAHs. The Flu/Flu+Pyr ratio is 0.44 for vehicular emissions and especially for emissions from catalytic converter equipped automobile (Rogge et al., 1993). The ratio in this study was 0.48 which showed a relationship to vehicular emissions. It has been shown by Bi et al. 2003 that the value for IcdP/BghiP+IcdP is 0.56 for coal emissions. In this study, the value for IcdP/BghiP+IcdP is 0.42 and is rather closely to the range of 0.35-0.70 indicating emissions from diesel engines (Rogge et al., 1993). The above values are in well agreement with the values of M. Kalaitzoglou et al. 2004 concerning although TSP particle-phase PAH concentration. Because of such results on the PM1 and particle-bound PAHs concentrations for air at Kozani is described for the first time, new field campaigns are under way.

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$PM_{2.5}$ site/seasonal variability in Ireland: chemical analysis and toxicological effects

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Keywords: *$PM_{2.5}$, chemical composition, toxicity, chemometrics*

Until recently little information about the chemical composition and toxicological effects of particulate matter (PM_{10} or $PM_{2.5}$) collected in Ireland has been available. However since 2003 University College Cork has taken advantage of two programmes run by the Irish EPA and the Marie Curie Transfer of Knowledge Scheme to initiate a systematic monitoring and analysis effort focussing on fine particulates. The resulting studies are fully relevant to the aims and objectives of COST 633; therefore Ireland formally joined the grouping in 2007. This presentation centres mainly on results obtained in a sampling campaign (ERITASK) performed in Cork City between 2004 and 2006. However some very recent data from a new campaign (ELIPSE) directed toward monitoring shipping traffic in Cork Harbour will also be discussed.

Project ERITASK

This field campaign/laboratory study is the first of its kind in Ireland to encompass the four necessary stages to fully characterize ambient $PM_{2.5}$ as a basis to predict its potential effects on health. The stages are: 1.Sampling; 2.Physico-chemical compositional analysis; 3. Toxicological studies; 4.Chemometrics/statistical analysis. The ultimate aims are to investigate: (i) the hypothesised link that exists between $PM_{2.5}$ composition and its potential toxicity and (ii) any observed geographical and seasonal differences for $PM_{2.5}$ sampled in the urban area of Cork City.

$PM_{2.5}$ was collected at three sites located throughout Co. Cork, Ireland: the Urban/City Centre, an Urban Background Location and a Rural Site. The collections were made on Polyurethane foam (PUF) filter substrates using a high volume cascade impactor sampler ($900Lmin^{-1}$). Analyses for organic components (such as PAHs, alkanes and quinones) were made using GC-MS techniques. However this presentation will provide a synopsis of the main results obtained for the inorganic content, particularly the transition elements, because they have long been recognised as toxic components of particles found in occupational settings. In addition there are a number of well-characterised pathological diseases caused by the inhalation of particles of specific metallic compounds. (Samet *et al*, 2007)

Elemental concentrations of a representative suite of 20 metals were determined using microwave extraction and ICP-OES. In addition, aqueous extracts were analysed, after sequential agitation/sonication to quantify the solubility (bioavailability) of the different metal components. This procedure was also utilised in the determination of the inorganic ion content of the $PM_{2.5}$ by ion chromatography. The % total carbon was determined by use of a CE440 Elemental Analyser.

To investigate the biological effects of $PM_{2.5}$ at a sub-cellular level, the human epithelial pulmonary A549 cell line was exposed for 72hrs to different concentrations of $PM_{2.5}$ (0, 5.5, 11.0, 22.0 $\mu g/cm^2$). As an index of cytotoxicity after $PM_{2.5}$ exposure, the activity of LDH released from the cytosol of damaged cells into the supernatant was determined using the appropriate colorimetric detection kit from Roche. *In vitro* cell proliferation and cytotoxicity after $PM_{2.5}$ exposure was also determined using the resazurin assay. The reduced glutathione (GSH) assay (Hissin *et al*., 1976) was employed to evaluate how GSH, one of the primary bio chemicals for cell defence, can be influenced by PM toxicity. Hence in the ERITASK study the ability of the three different concentrations to induce release of the pro-inflammatory cytokines interleukin-6 (IL-6) and interleukin-8 (IL-8) from human epithelial lung cells (A549) was investigated. The most potent samples exhibited a relatively high content of transition metals (*e.g.* Fe and Zn); this observation was found to be especially true for the summer samples collected at the three sites when looking at IL-6. Significant cytotoxicity was noted only at higher concentrations of particle exposure, which would indicate that chemical composition of $PM_{2.5}$ is a critical determinant for the marked differences in potency to induce cytokine responses in human epithelial lung cells. A concentration-dependence was noted for the toxicological assays: ROS, IL-6 and LDH. However the IL-8 response did not always increase with increasing particle dose over the 5.5-22.0 $\mu g/cm^2$ range. In these cases, the decrease in IL-8 at higher particle concentrations could not be explained by loss of cell viability.

PCA chemometric methods were then employed to determine any correlations between chemical composition (*e.g.* redox active metals) and toxicological endpoints (*e.g.* ROS). These studies highlighted that the toxic profile of $PM_{2.5}$ is clearly linked with the elemental content and identified FOUR different active components: The first Principal Component correlates ROS and transition metals. It allows the separation of City/UBS (polluted) from the rural (unpolluted) samples. For the second Principal Component, a correlation was noted for crustal/soil-derived elements (Ca, Mn, Al, K^+) and the toxicological endpoints (IL-6, IL-8, LDH, endotoxin). The third Principal Component identifies relationships between: (i) sea-spray/marine species (Na^+, Cl^-, Mg, Ti) and IL-8, and (ii) secondary inorganic aerosols species (SO_4^{2-} NH_4^+, NO_3^-) and ROS, IL-6 and LDH. The fourth Principal Component shows a positive correlation for hydrocarbons, Ti, Al with LDH. This relationship was found to be especially clear for the City site during winter and autumn when heating systems are utilised more frequently.

Project ELIPSE

Seagoing ships are not subject to the stringent air quality legislation which is applied to land-based transport. Emission estimates demonstrate the fact that ships make significant contributions to the pollution inventories of SO_2, CO_2, NO_x, organic compounds, and PM. For example, the average sulfur content of marine heavy fuel oil used in European waters is 27,000*ppm* and it is estimated that by 2010 emissions from ships will equal three-quarters of the EU total for sulfur. Furthermore hazardous constituents from the combustion of marine fuels ("bunker fuels"), including arsenic, cadmium, chromium, lead, nickel, vanadium and polycyclic aromatic hydrocarbons (PAH) can also be released into the air.

Cork Harbour is the second largest natural harbour in the world in terms of navigational area. There are four main commercial berthing locations distributed within the harbour capable of berthing ships up to 90,000 DWT, with the annual total number of vessels berthing being in excess of 4,000. Therefore the main aim of ELIPSE is to assess the contribution that a range of products associated with marine diesel ("bunker fuel") combustion, in-port, make to the ambient air pollution of Cork City and Harbour. The project comprises: (i) a twenty-eight month PM monitoring campaign (from December 2006) at two selected port-side sites and a background/pristine costal site; (ii) "total" chemical analysis of inorganic and organic components of collected PM; (iii) real-time measurements of parameters such as EC/OC splits and S(IV) to S(VI) oxidation. A recently awarded TSI Aerosol Time-of-Flight Mass Spectrometer will soon be deployed in order to "catch ship plumes" in real-time. Receptor modeling techniques will also be applied to identify and apportion sources of emissions to the atmosphere. Finally physico-toxicological analysis of the collected PM will be performed to provide assessments of possible adverse impacts on human health from the airborne particulate components originating with shipping traffic.

The first stage of this study has involved a preliminary campaign directed toward the collection of $PM_{2.5}$ for the winter season (2006-2007). Collections for this period were made on polyurethane foam (PUF) filter substrates using a high volume cascade impactor sampler operating at a flow-rate of $1100 Lmin^{-1}$.

The ambient concentrations of water soluble (bioavailable) inorganic ions including sulfate, nitrate, ammonium, sodium and chloride were determined by ion chromatography following aqueous extraction from the collection substrate. Concentrations of twenty metals were determined using an acid digestion and microwave extraction method followed by ICP-OES.

Correlations between selected species have been determined in our initial analysis. For example, high correlation coefficients were observed for: (i) Ca^{2+}, Mg^{2+}, Na^+, Cl^- ions suggesting a sea spray source; (ii) NH_4^+/ SO_4^{2-} and NH_4^+/ NO_3^- suggesting a secondary sulfate/nitrate source; (iii) Zn and Pb and (iv) Fe with Ni or Pb suggesting anthropogenic sources. Further receptor modeling techniques will be performed in order to identify and apportion pollution sources in the Cork Harbour region.

Acknowledgements:
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Studies on carbonaceous material in fine particulate matter in Finland

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Keywords: atmosphere, fine particles, carbonaceaous aerosol

Half of the fine particulate matter in typical urban air is made of carbonaceous material. Major part of this is organic carbon (OC). Soot (called elemental carbon, EC or black carbon, BC) from incomplete combustion has lower concentrations, but it forms an important fraction of carbonaceous material. The concerns of potential health-related effects of fine particles are very much due to carbonaceous fine particles. In this work a set of campaign-based and a long-term measurement data on carbonaceous material in fine particulate matter in Helsinki will be presented. Most of the data is from an urban background station close to the Helsinki downtown area (SMEAR III, 60°20'N, 24°97'E, 26 m above sea level).

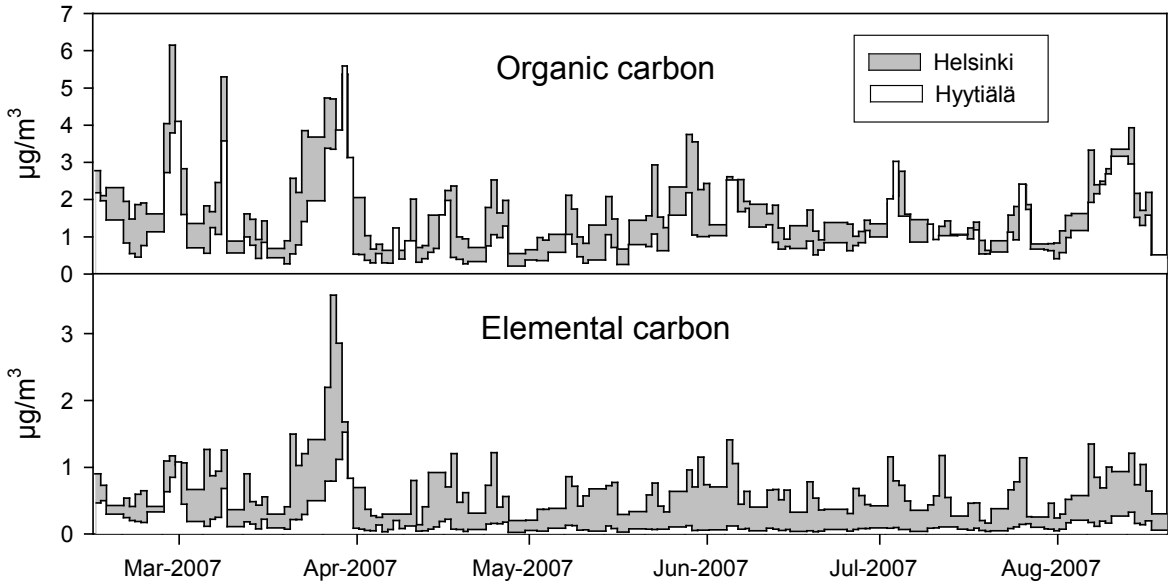

Figure 1: High concentration periods of OC during 2007 display similar concentrations in Helsinki (SMEAR III station, urban background site) and in Hyytiälä (SMEAR II station, rural), which are more than 200 km apart from each other.

In Helsinki, of carbonaceous particulate matter there is the longest time series for black carbon as measured with the aethalometers. The time series covers several years since 1996. This enabled a study on the trends of BC concentrations in Helsinki (Järvi et al., 2007). Comparison between different years was done for selected periods, when data from all campaigns existed in an equal manner. The effect of traffic and meteorological variables to the measured BC concentrations were taken into account. Recently the BC measurements

with an aethalometer were completed with the measurements by using two Particle Soot Absortion Photometers (PSAP). Use of preimpactors allowed PSAPs to measure different size fractions, one thought to represent fresh diesel soot ($PM_{0.17}$) and the other (PM_1) the sum of fresh and aged (long-range transported) BC.

Organic carbon has been studied using various sampling and analytical methods. Thermal-optical transmission method has been used for size-selected ($PM_{2.5}$, PM_1) and size-segregated samples. The offline methods were completed with an online (semi-continuous) set up in summer 2006. The water-soluble fraction of organic carbon (WSOC) was analysed from filters and impactor substrates using the TOC-V_{CPH} organic carbon analyzer (Shimadzu) with a high sensitive catalyst. Chemical speciation has been till now limited. Some organic acids have been determined from PM_1 samples using an ion chromatography (IC) and a liquid chromatography mass spectrometry (LC-MS). The latter have been used also to identify organic biomass burning tracers, monosaccharide anhydrides (mainly levoglucosan), from filter and impactor samples.

In the BC trend study, a small decrease of BC concentrations (from 1.11 to 1.00 $\mu g\ m^{-3}$) was found from 1996 to 2005 for the considered periods. The diesel engine technology and diesel fuel have developed much during ten years, but the anticipated clear decrease in BC concentrations is compensated by increasing number of vehicles.

When looking at the BC in two size fractions using the PSAP setup, the data did not show big differences in the diurnal variation between the two fractions. This is most likely due to the fact that the measurement site is a few hundred meters from the major roads, and long range transported and especially regional aged aerosol dominates BC mass.

During high concentration periods of organic carbon long range transported or regional secondary aerosol dominates which can be seen from the same concentration levels in Helsinki as in Hyytiälä (SMEAR II) station 200 km north from Helsinki (Figure 1). Annually WSOC contributes 30-80% of OC in Helsinki. Levoglucosan was found to be good tracer for both natural and anthropogenic biomass burning. Combining emission rates of levoglucosan and OC from a laboratory scale wood combustion experiment (one fireplace) to corresponding ambient concentrations, it was possible to estimate how much wood combustion contributes the particulate matter concentrations in Helsinki. This crude calculation suggests that during winter months (October-March) typically 40% of organic carbon is from biomass combustion.

The studies carried out on carbonaceous particulate matter in Helsinki, Finland, show that offline analysis can gather useful data when conducted on long-term basis, and online measurements are needed for source- or process-specific considerations. As shown in connection of biomass burning tracer (levoglucosan), organic speciation is sometimes useful in assessing contribution of sources of ambient particulate matter.

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Computational modelling of aerosol transport and DEPOSITION IN human respiratory tract

Project of the Ministry of Education of the Czech Republic No. 1P05OC028

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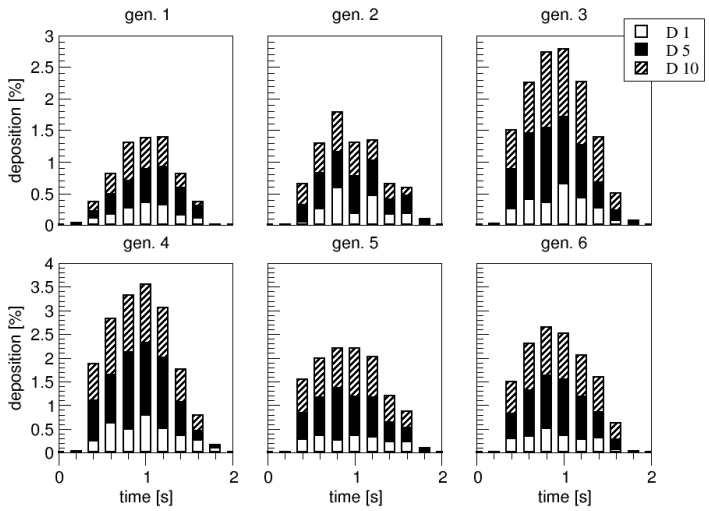
ABSTRACT

The paper presents results of computational modeling of aerosol transport and deposition of three different size classes in the upper human airways (tracheo-bronchial tree) up to 6th bifurcation. As a geometrical model, a real CT scan of a living human was acquired from St. Anna University hospital in Brno. Two regimes, namely resting conditions and maximum exercise were simulated. Both regimes were calculated in the steady regimes and in the transient mode inspiration /expiration according to a sinusoidal breathing cycle. Three size classes were assumed in the inlet to the trachea, namely 1, 5 and 10 μm with corresponding concentrations. Calculations were done using standard k-ω model of turbulence and Euler-Lagrange Eddy Interaction Model for particles transport; inlet conditions were ascribed as "inlet" with a given velocity, outlet as pressure conditions with identical relative pressure in all airways terminations. Results first show a difference in the deposition acquired in the steady regime and full breathing cycle. From that it follows that any simulation performed in the steady regime doesn't reflect correctly a real situation in the breathing. In the full breathing cycle one can observe an asymmetry in the flow rate distribution and a corresponding asymmetry in the particles deposition between the left and right airways and very different deposition rate in the individual generations. Very strong effect can be observed in the deposition for individual time of inspiration where more than 60% of particles deposit before the inspiration peak. As for the individual size classes, difference is seen in the deposition of 1, 5 and 10 μm in correspondence with individual generations.

Airways image mapped on the human torso



Relative deposition by mass of the total in individual generations

Particulate Matter in urban air: transport and deposition in urban area

Project of the Ministry of Education of the Czech Republic No. 1P04OC633.001
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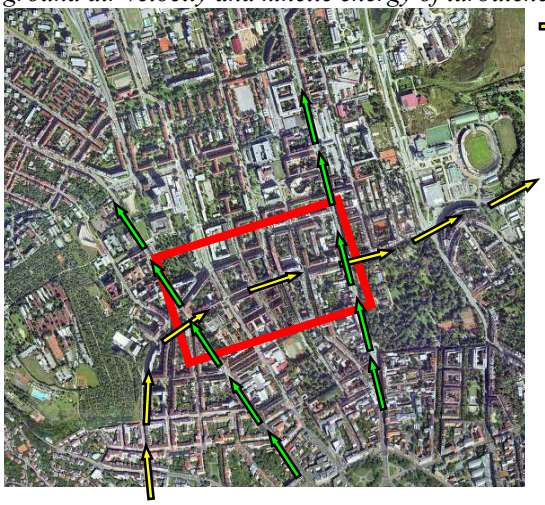
ABSTRACT

Within the project, different ways of PM dispersion modeling in suburban areas is carried out. The study is focusing on dispersion of particulate matter originating from traffic using CFD code. Different options of CFD technique and different approaches were tested. The numerical predictions were compared with measurements carried out in a heavily built up urban area. The computational model represents part of the area in the center of the city of Brno approximately 0.5 x 0.5 km and includes one long street canyon and four streets that cross the main street canyon. Boundary conditions for wind speed assume specified wind speed in the horizontal layer where it was measured in a nearby meteorological station. As a model of turbulence, k-ε RNG model is used. Traffic was simulated with an original model developed previously by the authors and takes into account traffic density, speed of cars and number of traffic lanes. PMs are assumed spherical with a density of 300 kg/m^3. Only PM10 are modeled that also were measured in several locations within the street canyon and crossing streets at the ground level. Besides the PM dispersion and deposition, also re-suspension driven by ground air velocity and kinetic energy of turbulence was modeled.



The AQUELLA project as an Austrian contribution to COST 633

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Keywords: PM10, aerosol measurements, source apportionment, urban impact

Within AUPHEP (Austrian Project on Health Effects of Particulates), this project was carried out in three Austrian cities from 1998 until 2004 (e.g. Hauck et al. 2004, Gomiscek et al. 2004, Neuberger et al. 2004), the term of the 'urban impact' as the difference between observations at the urban and the local background sites was defined. On an annual basis only low aerosol generation acitivity in the city was found in case of Vienna, i.e. the urban impact was just an 'addition' to a significant regional background concentration (Puxbaum et al. 2004). The conceptual model of the 'urban impact' was already presented at the COST meeting in Ispra in 2004.

Subsequently the AQUELLA project was launched in Austria (and also introduced in Ispra 2004). The aim of AQUELLA was to identify the main sources responsible for the exceedances of limit values for PM10 in Austrian cities. Aerosol samples collected within the routinely operated air monitoring networks of the Austrian Provinces (Vienna, Styria, Salzburg, Carinthia, Lower Asutria, Upper Austria and Burgenland) were analysed for a number of chemical species attempting mass closure. Until now the sampling was carried out at 30 sampling points all over Austria (see Table 1).

Table 1: Sampling sites and sampling periods within AQUELLA

Province	Number of sampling points	Sampling period
Vienna	4	Jan – Dec. 2004
Styria	8	Graz + Bockberg: Jan. – Dec. 2004, others: several months in 05 or 07
Salzburg	3	Jan.-Dec. 2004
Carinthia	4	Oct. 2004 – July 2005
Lower Austria	5	Jan. 2005 – June 2005
Upper Austria	4	Apr. 2005 – March 2006
Burgenland	2	Apr. 2007 - ongoing

Chemical analysis comprised soluble ions, total carbon, black carbon, organic carbon and carbonate carbon, anhydrosugars, cellulose, HULIS (humic like substances), selected PAH, C23-C33 alkanes, selected mono- and dicarboxylic acids, selected resin acids, nonanale and selected metals. Sometimes, especially when the limit value was exceeded, daily samples were analysed, in other cases 'pools' were formed to get average results for similar conditions. In addition to ambient aerosol samples source samples (industry, agriculture, road dust, traffic, combustion of biomass, …) were collected to get information of the chemical composition of potential emission sources.

Based on 'Macro Tracers ' the results of the chemical analysis were related to potential emissions sources. These 'Macro Tracers' were ammonium, sulphate and nitrate (to get the inorganic secondary aerosol), silicium and calzium (to get mineral dust), sodium chloride (to

get thawing salt), anhydrosugars (to get wood smoke), elemental carbon (to get traffic emissions; contribution of other sources i.e. wook smoke), cellulose (to get plant debris) and HULIS (to get the secondary organic aerosol). Furthermore a CMB model was applied.

Thus the work carried out within AQUELLA is linked to the COST 633 topics ***aerosol measurements*** **(WP1)** as well as ***modelling*** **(WP2)**.

In case of Vienna an Styria sampling and evaluation of the samples is finished and reported (H. Bauer et al. 2007a, H. Bauer et al. 2007 b).
Highest PM10 concentrations in Graz were determined during the cold season. Road dust (containing mineral dust and thawing salt), inorganic secondary aerosols (i.e. ammonium sulphate and –nitrate), wood smoke and traffic emissions (including tire wear, off-road and fossile sources) were determined to be the main sources responsible for exceedances of limit values in the city. It has to be held in mind that during 50 % of the exceedances the aerosol concentrations determined at the background station is already above 30 µg/m³. Thus reduction of the regional background (mainly inorganic secondary aerosol and wood smoke) is as important as the reduction of the urban impact (mainly mineral dust and thawing salt).
Similar conditions were identified for Vienna, whereby the reduction of the background seems to be even more important than for Graz.

Acknowledgements
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Distribution of nanoparticles in the organism after administration to the lungs

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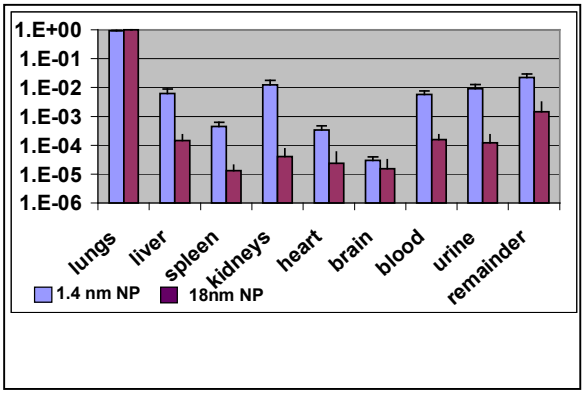
Introduction: Currently there is ongoing debate about biological mechanisms and the role of particle parameters like surface parameters of insoluble nanoparticles (NP) on translocation across the alveolar air-blood barrier (Oberdörster et al., 2005). Here we challenge the question of size using either 1.4 nm gold clusters consisting of a stable conformation of 55 atoms or 18 nm gold colloids each coated with a negatively charged ionic ligand.

Methods: Healthy adult control or pregnant WKY rats received either intratracheally (IT) or intravenously (tail vein, IV) radio labelled gold in 50 µl of physiological saline. Rats were killed 24-hours after administration and all organs and tissue samples as well as the remainder and excretion were analyzed gamma-spectrometrically achieving 100% balance of the NP (Semmler et al., 2004).

Results: 24-hours after IT administration lung retention (>90% of administered particle mass) dominated for both particle sizes (Figure 1). However, while 7% of clusters had been translocated into circulation and secondary organs, colloids translocated only a 25-fold less. Similarly, 0.6% of clusters still circulated in blood while only a 30-fold less of colloids were still circulating in the blood. 24-hours after IV administration of clusters or colloids, NP retention dominated in liver (about 50% for the 1.4 nm Au-cluster and about 94% for the 18 nm Au-colloids), spleen (about 2% for both particle sizes) and lungs (0.7or 0.1%), respectively. However, while 4% of clusters still were circulating only a 130-fold less (0.03%) of colloids was found in blood. The 2000-fold difference in urine was even larger: 6% clusters versus 0.003% colloids.



24-hours after IV-injection of the above named gold NP in pregnant rats we found a rather strong uptake of these NP in the placenta (about 3% for the 1.4 nm Au-cluster and about 0.02% for the 18 nm Au-colloids) and also in the foetus (0.06% and 0.005%).

Discussion and conclusion: Featuring the same NP matrix, the size of these gold NP clearly affects translocation kinetics across the alveolar air-blood barrier or vascular endothelium leading to more prolonged circulation and higher accumulation in secondary target organs of the 1.4 nm NP when compared to the 18 nm NP. Both NP accumulate in all organs to a varying but detectable extent; in particular these NP are able to cross all membranes studied: the air-blood-barrier in lungs, the gastro-intestinal-wall, the blood-brain-barrier as well as the placenta of pregnant rats reaching the foetus. Potential adverse health effects in secondary target organs need further investigations.

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Particulate matter modelling in selected EU states: an overview of the activities of COST Action 633

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Keywords: particulate matter, modelling, exposure Increased understanding of the health issues associated to high concentrations of particulate matter (PM), identified this pollutant as one of the critical air pollution problems. Estimates from the European Environment Agency (EEA, 2003) indicate that exposure to PM causes approximately three million deaths per year in the world. Exceedance of PM thresholds has been reported by the majority of the European Union (EU) member countries, mainly in urban agglomerations, where human exposure is also higher (EEA, 2005). Fine particulates ($PM_{2.5}$) are considered to be responsible for increased mortality over Europe. Anthropogenic $PM_{2.5}$ levels are expected to be responsible for a loss of ten months of life expectancy in some regions of Europe by 2020, in spite of application of the current legislation devoted to air pollution control (Amann *et al.*, 2005). It is also recognized that adverse effects from PM long-term exposure occur whatever the concentration levels are (WHO, 2006; Pope *et al.*, 2002 in Thunis *et al.*, 2007). In this scope, the main purpose of this paper is to overview critically the PM modelling activities in Europe aiming to identify advantages and gaps and to recommend future use and developments.

As a first approach, a compilation of data on particulate matter modelling was carried out by means of a questionnaire, which was distributed via e-mail among researchers from COST633 Action member states. The questionnaire was designed to identify PM modelling work in a common usable framework, based on the knowledge of the COST633 members. Table 1 shows the information required.

Table 1 – Information required to COST633 member states.

country	case study	model used + webpage	PM modelling		time resolution	spatial resolution	domain	validation	contact person	available documents	other info
			primary	secondary							
Austria…											

Figure 1 shows the distribution and classification of models used by COST633 member countries, as reported to the questionnaire.

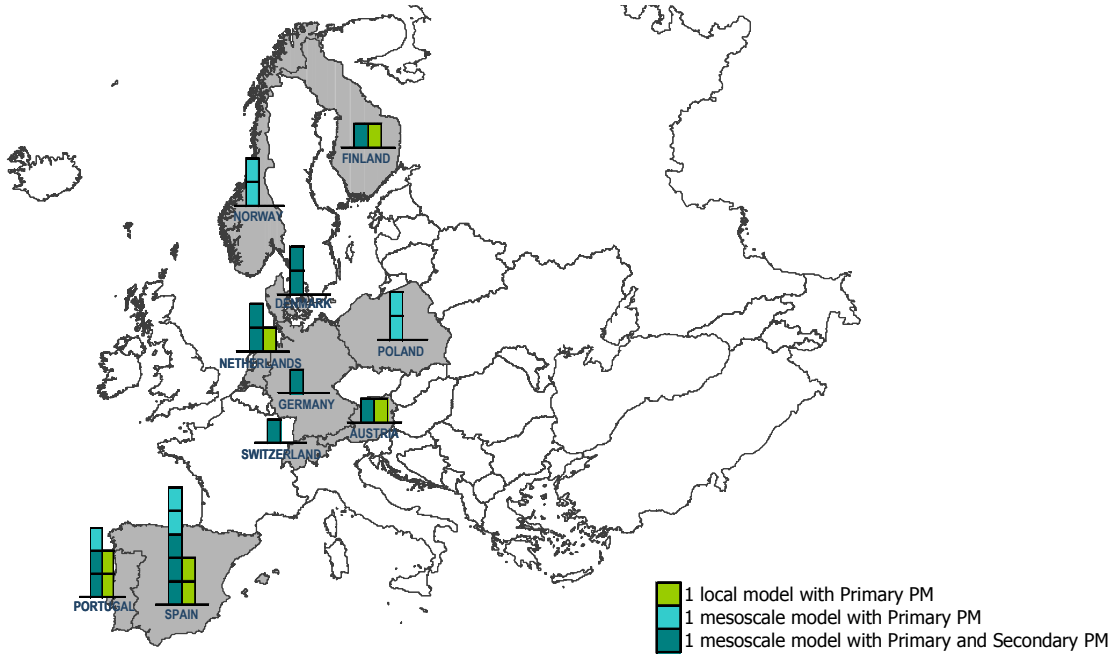

Figure 1: Distribution and classification of types of models used by COST633 member countries.

Ten member countries replied to the questionnaire reporting a total of 30 case studies applications. According to this information, several models are applied, in a total of 20, with different scopes and covering different modelling scales, from the local (only simulating primary PM) to the regional scale. Validation work is associated to each reported case study. The analysis of the results shows that primary aerosols were simulated in all the case studies, whereas secondary aerosols were included in 50% of the cases, estimating not only PM_{10}, but also $PM_{2.5}$ and SOA (secondary organic aerosol).

The results of the questionnaire were considered not enough to proceed with the analysis. Hence, an extensive bibliographic review on the following topics has been done: types of models, input data, modelling applications, models validation and future developments.

The main conclusions of the work done is that numerical models are useful tools for the mapping of air pollutants, once the monitoring networks are able to assess the air quality in the single stations of the monitoring network, and not a whole area of interest. Also, knowing the physical state and composition of atmospheric aerosols is of great significance, especially when anthropogenic perturbations are examined, because of their role in atmospheric processes and climate forcing. Mathematical models which simulate the evolution of both gaseous and aerosol species have only recently started to appear, due to the complexity and variability of the processes in which particulate matter is involved (Nenes, 1999).

All models are useful and the choice of an appropriate model is heavily dependent on the intended application: the type and dimension of the area, the pollutants to simulate, and the final goal of the study (air quality management, exposure and health estimations, etc). Even though a model may be freely available, it does not follow that it is necessarily the most appropriate for the situation under investigation. In particular, the science of the model must match the pollutant(s) of concern. For example, if the pollutant of concern is fine particulate matter, the model chemistry must be able to handle reactions of NO_x, SO_2, volatile organic compounds (VOC), ammonia, etc. Reactions in both the gas and aqueous phases must be included, and preferably also heterogeneous reactions taking place on the surfaces of particles. Apart from correct treatment of transport and diffusion, the formation and growth of particles must be included, and the model must be able to track the evolution of particle mass as a function of size. The ability to treat deposition of pollutants to the surface of the earth by both wet and dry processes is also required.

Air quality models are already widely applied for exposure and health related issues, but an effort is still needed to take more advantage of the third generation models (Eulerian models including aerosol chemistry) on epidemiological studies.

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Overview on COST 633 Action in Hungary

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COST 633 Action was signed by the Hungarian Authorities on 16. 07. 2002. The Hungarian contribution to COST 633 is mainly concentrated to the activity of Working Group 1 and partly to WG 3. Unfortunately Hungarian participation in WG 2 could not be organized. The main objectives of COST 633 was presented on the 8th Hungarian Aerosol Conference (May 25-26, 2006) organized by the Hungarian Aerosol Society. As a result, four institutions (Eötvös University, Hungarian Meteorological Service, Institute of Nuclear Research of the Hungarian Academy of Sciences, and University of Pannonia) agreed to provide their aerosol data to the COST 633 data base.

The Hungarian data were summarized and presented on the COST 633 Conference in Vienna, 2006 (Mészáros et al., 2006). The temporal and spatial variability of main aerosol characteristics (fine and coarse mass concentration, sulfate, soot, etc. concentrations) were summarized and evaluated. We concluded that the fine aerosol mass at different urban (Budapest, Debrecen), and regional background (K-puszta) sites is comparable. In Budapest the mass concentration decreased with time in the last several years, while on the other two sites no significant trend was found. At all three sites sulfate concentrations were comparable and showed important decreasing tendency. On the other hand, fine soot concentration is low at K-puszta (~1μgm^{-3}), and it is increasing with increasing city size (Debrecen with ~ 200 thousands and Budapest with around 2 million people, soot concentration is more then 2μgm^{-3} and 6-9μgm^{-3}, respectively). On the other hand, our data were also involved in the study of the PM characteristics across Europe (Putaud et al., 2007), which was presented at the European Aerosol Conference 2007 (Salzburg, September 2007).

In spite of the fact that the Hungarian contribution in WG2 and 3 was not as important as in WG1, scientist also obtained important results in these research fields. Thus, the deposition of inhaled particles in the human respiratory system was widely studied (e.g. deposition patterns of particles of different sizes in healthy and diseased bronchial airways). Also, regional and local scale transport modeling of different constituents (e.g. toxic heavy metals) has been regularly done.

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Identification of factors influencing chemical composition and concentration levels of chosen fractions of atmospheric aerosols and an assessment of health effects in people inhabiting urban industrial areas associated with exposure to these agents

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Keywords: ambient air pollution, particulate matter, meteorology, environmental epidemiology, public health.

INTRODUCTION

Particulate matter pollution is one of the most serious environmental hazards of the beginning of XXI century. Intensive development of transport together with still insufficiently reduced industrial dust emission cause that quite restrictive admissible values of particulate matter in air are permanently being exceeded in most of European countries. At the same time current epidemiological evidence confirms a significant association between PM concentrations, daily total and specific (respiratory and/or cardiovascular) mortality. Similar relationship concerns daily hospital admission and particulate air pollution. A development of statistical methods and measurement techniques, including the establishment of automatic measurement systems makes it possible to control the association between air concentration of different PM fractions and meteorological parameters.

In Poland, after the political and economical change in 1990 the quality of environment became one of the national target priorities, and the effort towards environmental clean-up has resulted in a substantial improvement of ambient air quality (Ministry of Health 1996). The largest effect was seen in the urban area of Katowice (Poland), known for high levels of industry-related air pollution. A time-series analysis performed in 1994-5 and in 2001-2 revealed the most significant effect of exposure to sulphur dioxide (SO_2), followed by particulate matter (PM_{10}) (Zejda 2000, Kowalska 2007). Since then the quality of ambient air has significantly improved. Between 1994 and current ambient air daily average concentrations of pollutants have decreased by about 40% in the case of SO_2 and by about 15% in the case of PM_{10}.

The aim of this work was to identify factors determining concentration levels of particular matter as well as its profile (chemical composition) together with the assessment of exposure of industrialized urban population under conditions of reindustrialization and reclamation. For this purpose the unique measuring techniques and research methods were being used. The project complied with COST 633 Action and in particular with the scope working groups WG1 and WG2. It was also relevant to regulate legislation proposals concerning $PM_{2.5}$. Recommendations concerning the integrated human exposure assessment and health impact assessment associated with chosen fractions of aerosols were being formulated.

AIMS OF PROJECT

The aim of the research was measurement dependence between meteorological conditions and particulate matter on human health effects.

Main goals were being reached through a number of specific tasks:

- ✓ Development of methodology to assess the composition of PM fractions and primary source inventory in the case of Upper Silesian Agglomeration.
- ✓ Assessment of chemical composition of PM_1 and $PM_{2.5}$ and their concentrations in chosen areas of Upper Silesian Agglomeration.
- ✓ Identification of meteorological factors responsible for high concentrations of chosen aerosols in ambient air.
- ✓ Epidemiological study of potential health effects associated with air pollution due to chosen aerosols, establishment of threshold concentrations relevant for human health.
- ✓ Development of methodology to assess the seasonal and spatial variability of PM_1, $PM_{2.5}$ and PM_{10} fractions with the aim of using PM_{10} data to predict the spatial distribution of $PM_{2.5}$ concentrations.
- ✓ Health risk assessment due to chosen fractions of particulate matter in Upper Silesian Agglomeration.
- ✓ Short term forecasts of high concentration episodes of $PM_{2.5}$ and PM_{10} fractions.
- ✓ Characterization of indoor air aerosols in Upper Silesian Conurbation and quantitative exposure assessment to respirable fractions of particulate matter.
- ✓ Development of integrated exposure assessment concerning chosen aerosols in ambient air together with health impact assessment.

RESULTS

Despite the fact that ambient air quality has improved considerably during recent years, episodes still occur when particulate matter concentrations exceed the admissible limits. It is well known that the occurrence of high levels of air pollutant concentrations is associated with certain well-defined meteorological conditions. The study analyzed the principal causes of air pollution and identified the best subset of features: meteorological data and air pollutants concentration, in order to predict its short-range concentration.

The classification of meteorological situations responsible for concentrations particulate matter, particularly for high level values was made with selected data mining methods as: Fourier analysis, multiple linear regressions (MLR), artificial neural networks (ANNs) and Kohonen's self organizing networks with 'conscience'. Results of carried out elementary analysis are presented in Figure 1 and tables below (Table 1, 2).

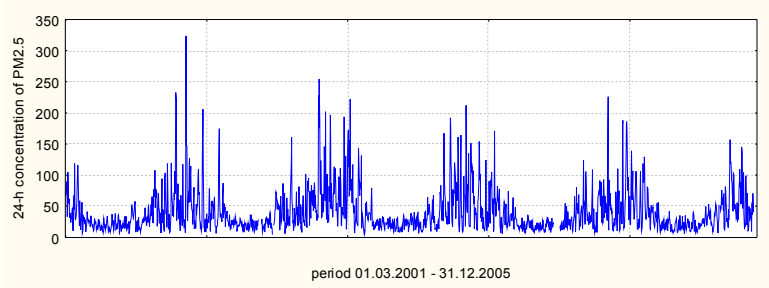

Fig.1. Daily concentrations of PM2.5 in the period from 01.03.2001 to 31.12.2005, Zabrze.

Parameters	PM_{10}	$PM_{2.5}$	ΔPM_{10}	$\Delta PM_{2.5}$
air temperature	-0.264	-0.270	-0.033	-0.037
air pressure	0.041	0.009	-0.001	-0.001
wind speed	-0.283	-0.196	-0.028	-0.030
relative humidity	-0.076	-0.059	-0.017	-0.014
vapour pressure	0.128	0.127	0.015	0.016
cloud amount	-0.027	-0.019	-0.002	-0.002

Table 1. Values of regression coefficients in association of meteorological parameters and mean daily PM concentrations, Zabrze.

Parameters	air temperature [^{o}C]	air pressure [hPa]	wind speed [m/s]	vapour pressure [hPa]	$PM_{2.5}$ [$\mu g/m^3$]	total deaths		hospitals admissions	
						CV*	R*	CV	R
average	8.9	998.2	2.4	9.8	41.7	25.3	2.2	27.3	8.7
yearly amplitude	10.5	1.9	0.7	6	24.3	2.7	0.6	1.8	1.3
weekly amplitude	0	0	0	0	4.7	0.8	0	8	4.3

Table 2. Data of meteorological parameters, daily PM2.5 concentration, daily count of deaths and hospital admissions in Zabrze. * CV – cardiovascular diseases; R- respiratory diseases

CONCLUSIONS

The results of meteorological factors influence on high level concentrations of PM_{10} and $PM_{2.5}$ in southern Poland allow drawing the following conclusions:

- ✓ Relation between $PM_{2.5}$ and PM_{10} variability from 60 to 70 % dependence on season. The obtained result was comparable taking into account another urban region in Europe.
- ✓ One can notice stronger relation between meteorological factors and $PM_{2.5}$ than between PM_{10}, but hourly increments of $PM_{2.5}$ are weakly associated with weather conditions.
- ✓ Sets of meteorological parameters and $PM_{2.5}$ the most influence on deaths from cardiovascular causes and the least on deaths from respiratory causes.
- ✓ Data mining methods despite computational limitations give promising results and could be used in developing better empirical methods of air pollution forecasts.

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Road-side traffic aerosols in Helsinki

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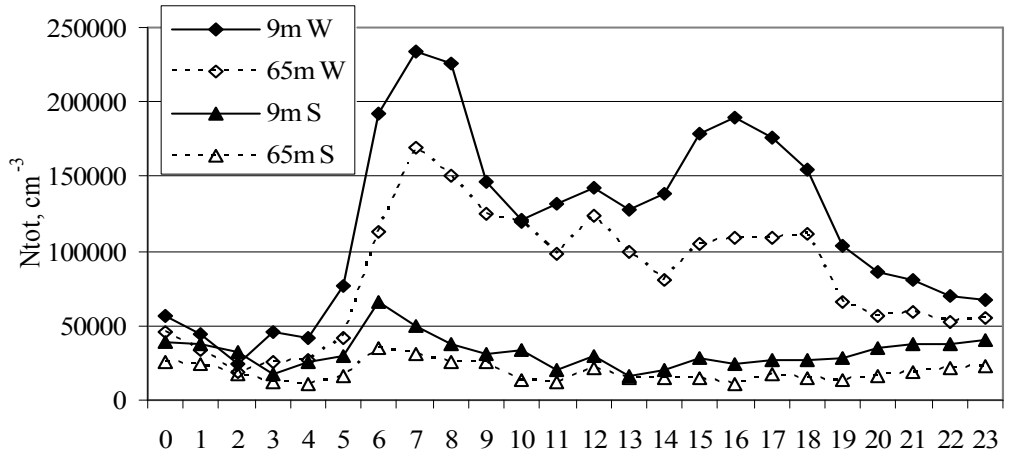
Keywords: traffic, particle number, black carbon

Road-side measurements of vehicle exhaust particles were conducted in four two-week campaigns in winter and summer of 2003 in Helsinki, Finland, in order to find out the influence of traffic to road-side number concentrations of different-size particles and to black carbon (BC) concentrations (Pakkanen et al., 2006). The work was one part of the Finnish contribution to COST 633/aerosol measurements.

Measurements were made at 9m and 65m distances from a major road. Particle number concentrations were monitored using both electrical low-pressure impactors (ELPI) and condensation particle counters (CPC). Black carbon was monitored utilising aethalometers. The average total number concentrations (Ntot) were much higher in winter than in summer, while the average BC concentrations were rather similar in both seasons. This can be seen in Figure 1, which presents the respective average diurnal variation of Ntot and BC for the year 2003.



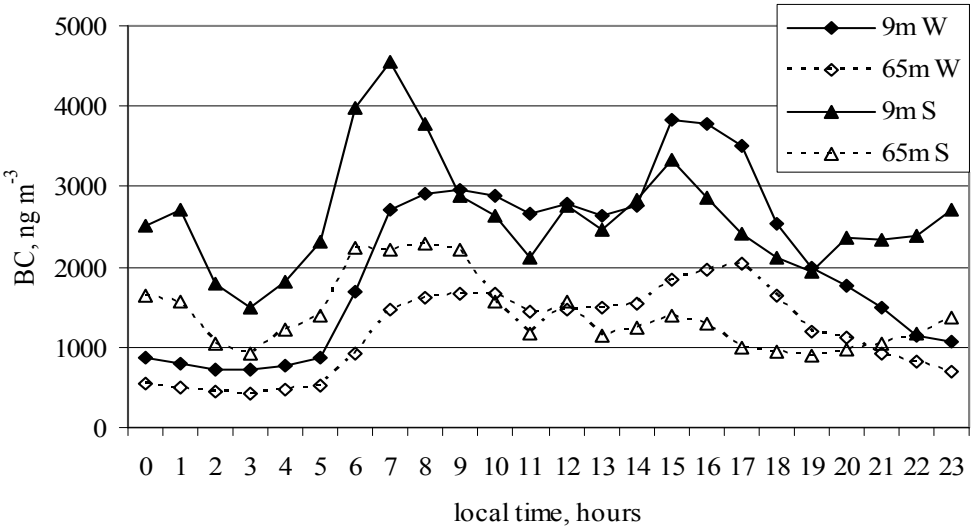


Fig. 1. Average diurnal variation of total particle number concentrations (upper fig.) and BC concentrations (lower fig) at 9m and 65m distances in winter (W) and summer (S), 2003.
The strong concentration differences between the 9m and 65m distances and the rush hour peaks (Fig. 1) indicate that traffic has a major influence on both particle number and BC concentrations.

A heavy traffic pollution event occurred on Friday, 21 February. There was practically no wind, temperature was about -5 °C, and dilution of traffic exhausts was minimized by a temperature inversion situation. In these severe circumstances the particle number size distributions showed, contrary to usual situations, a higher concentration of 30-63 nm particles at the 65m station (Fig. 2). During night time, before rush hours, particle growth by vapor condensation shifted a considerable fraction of nucleation mode particles from sizes 7-30 nm (measured by impactor after filter) to sizes 30-63 nm (impactor stage 1). During morning rush hours number concentrations increased by about an order of magnitude, making also self coagulation of nucleation mode particles important (Kerminen et al., 2007).

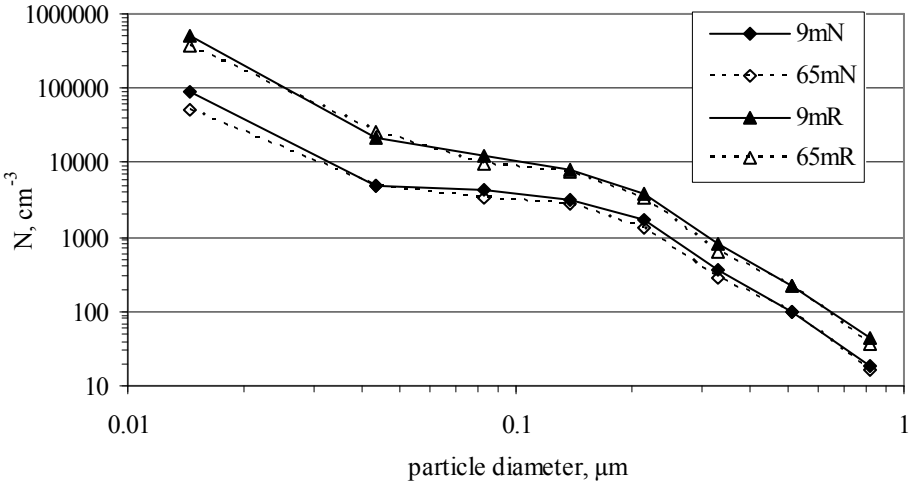


Fig. 2. Average particle number size distributions during the inversion situation, night (N) and rush hours (R).

Acknowledgements: The financial support of Finnish National Technology Agency (TEKES) and the Ministry of Trade and Communications is gratefully acknowledged.

Pakkanen T., Mäkelä T., Hillamo R., Virtanen A., Rönkkö T., Keskinen J., Pirjola L., Parviainen H., Hussein T., Hämeri K. (2006). *Boreal Environmental Research*, **11**, 295-309.
Kerminen V.-M., Pakkanen T., Mäkelä T., Hillamo R., Sillanpää M., Virtanen A., Rönkkö T., Keskinen J., Pirjola L., Hussein T., Hämeri K. (2007). *Atmospheric Environment* **41**, 1759-1767.

Dispersion of traffic emissions nearby a highway in Helsinki, Finland

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Keywords: mobile measurements, ultrafine particles, dispersion, size distribution, sulphuric acid

On-road and road-side measurements of vehicle exhaust particles were conducted in four two-week campaigns in winter and summer of 2003 and 2004 in Helsinki, Finland, in order to study dispersion of traffic particles in a vicinity of a major road. The work was one part of the Finnish contribution to COST 633/aerosol measurements.

Particle number concentration and size distribution as well as gaseous compounds (CO, NO, NO_2) were measured by a mobile laboratory "SNIFFER" (Pirjola et al., 2004) driving at a highway and standing at various distances of the road, 0-140 m from the roadside. Also urban background concentrations were measured. Particle number concentrations and size distributions were monitored using both electrical low-pressure impactor (ELPI) and scanning mobility particle sizer (SMPS).

The average number concentrations in winter were 2-3 times higher than the concentrations in summer (Pirjola et al, 2006). In winter 90-95% and in summer 86-90% of particles were smaller than 50 nm. The size distributions showed 2-3 modes peaking at 14-23 nm (nucleation mode), 40-50 nm (Aitken mode) and 120-125 nm (accumulation mode) (Fig. 1). In winter the nucleation mode shifted to larger sizes when moving downwind from the road.

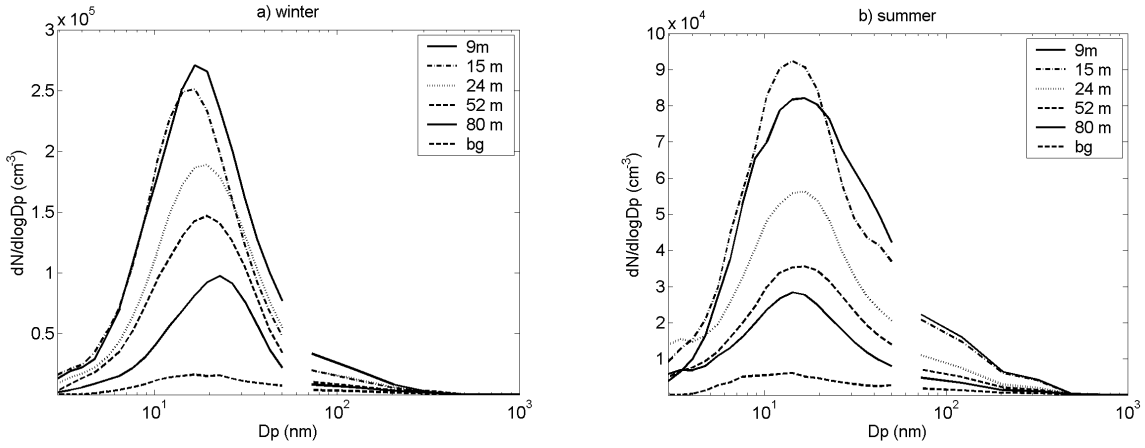

Fig. 1. Average particle size distributions as a function of distance from the roadside in winter (a) and in summer (b) conditions. Also shown are the urban background concentrations.

The equations for the concentration curves were derived, starting point being at the roadside (Fig. 2). When moving downwind 65 m from the roadside the average concentration

reduced to 39% in winter and to 35% in summer. Still the concentrations were more than twice the urban background concentration.

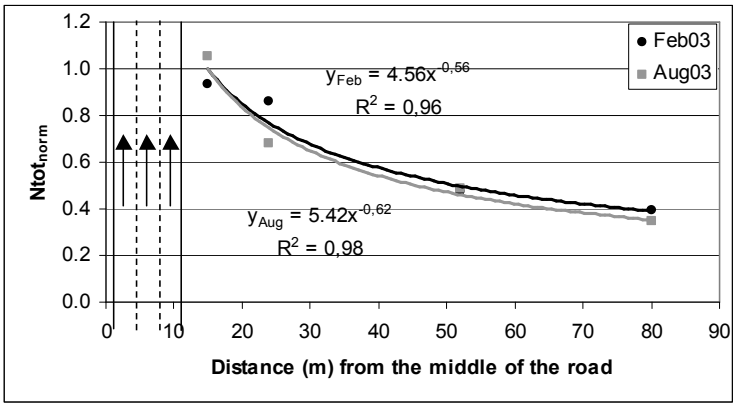

Fig. 2. Normalised total particle concentration as a function of distance from the middle of the road in winter and in summer, 2003.

The first measurements of gaseous sulfuric acid (GSA) in automobile exhaust were also done (Arnold et al., 2006). The experiment was made using a modern passenger diesel car equipped with an exhaust after-treatment system composed of an oxidation catalyst and a diesel particle filter. The diesel fuel used had an ultra-low sulfur mass fraction of only $5x10^{-6}$. Measured GSA number concentrations reached up to $1x10^{9}$ cm^{-3}. Freshly nucleated particles with diameters larger than 3 nm (N_3) were also measured. The concentrations reached up to $1x10^{5}$ cm^{-3}

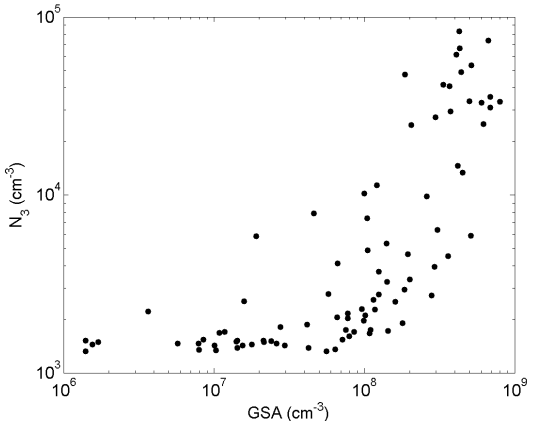

Fig. 3. Scatter plot for the stationary experiment of N_3 versus GSA.

The measured concentrations N_3 increase steeply with increasing GSA after GSA exceeds a threshold value in the range of $5x10^{7}$ – $2x10^{8}$ cm^{-3} (Fig. 3). This behavior strongly suggests that primary GSA is the key nucleating gas. However, growth of fresh particles with an initial diameter around 1 nm to the measured sizes requires far more abundant condensable gases, probably primary condensable organic vapour.

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Levels and composition of PM in Spain (1999-2007)

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Keywords: PM10, PM2.5, PM1, speciation, source apportionment, trace elements, number concentration

This presentation summarises the scientific contribution from Spain to COST 633, mainly in the area of aerosol measurements. The results of measurements and PM speciation studies performed at 37 monitoring sites (at least on an annual basis, but in some cases with 8 years for speciation and 12 years for measurements) across Spain are summarised. Data on PM levels, speciation, levels of around 40 trace elements, and source apportionment are presented. Finally the results on the interpretation of the variability of number concentration of aerosols in Barcelona (NE Spain) are also exposed.

Average levels of PM_{10}, $PM_{2.5}$ and PM_1 and chemical composition in Spain show significant variations across the country, with current PM_{10} levels at several industrial and traffic hotspots exceeding recommended pollution limits. Such variations and exceedances are linked to patterns of anthropogenic and natural PM emissions, climate, and reactivity/stability of particulate species. In 2006 around 40 and 70% of urban-traffic stations exceeded the annual and the daily PM_{10} limit values in Spain, respectively. When data from all type stations are included these figures still remain at 25 and 45%, respectively.

PM_{10} and $PM_{2.5}$ concentrations reach 14-22 $\mu gPM_{10}/m^3$ and 8-12$\mu gPM_{2.5}/m^3$ in most rural/regional background sites, 25-30 PM_{10}/m^3 and 15-20$\mu gPM_{2.5}/m^3$ in suburban sites, 30-46 $\mu gPM_{10}/m^3$ and 20-30$\mu gPM_{2.5}/m^3$ in urban background and industrial sites, and 46-60$\mu gPM_{10}/m^3$ and 30-35$\mu gPM_{2.5}/m^3$ heavy traffic hotpots.

Based on 2001-2005 Airbase data (http://air-climate.eionet.europa.eu/databases/airbase/index_html), regional background levels of PM measured in Spain are intermediate when compared with the low levels recorded in the Scandinavian countries (7-12 $\mu gPM_{10}/m^3$) and the higher levels recorded in central Europe (The Netherlands as an example recorded in regional background sites for 2001-2005 25-34 $\mu gPM_{10}/m^3$). When evaluating PM_{10} levels from the EMEP stations it is evidenced that the levels recorded in the Atlantic and Central regions of Spain are relatively low (12-14 $\mu g/m^3$ recorded as mean levels), whereas those recorded in the Southern regions are higher (18 and 21 $\mu g/m^3$). Levels measured at the Eastern side of Iberia are intermediate (16-17 $\mu g/m^3$, for most stations). This distribution is possibly caused by the progressive higher frequency and intensity of African dust outbreaks and low rainfall from the Atlantic regions to the Eastern and to Southern regions of Iberia.

Concerning $PM_{2.5}$, the mean annual levels range from 8 to 10 μg/m^3 in the Atlantic and Central Spain, from 10 to 11 μg/m^3 in Southern Spain and from 8 to13 μg/m^3 in Eastern Spain. It is clear that PM_{10} and $PM_{2.5}$ do not follow the same spatial variations over Spain. Thus, the highest $PM_{2.5}$ levels are recorded in regions from Eastern Iberia with high anthropogenic emissions, followed by sites from Southern Iberia, where probably the African dust has a higher incidence on $PM_{2.5}$ levels. Most of the remaining monitoring sites record levels close to 8μg/m^3.The ratio $PM_{2.5/10}$ reaches the lowest values in the Canary Islands and Southern Iberian Peninsula, with 0.4 and 0.5, respectively. In most of the other areas of the Iberian Peninsula the $PM_{2.5/10}$ ratio ranges 0.6 to 0.7, with the exception of the industrialized regions (such the Barcelona region), where the regional background ratio reaches 0.8 (Montseny).

PM_1 levels in regional background are continuously measured at Montseny since 2002, with a mean annual level of 11μg/m^3. The $PM_{1/2.5}$ ratio reached 0.8 constantly as an annual mean value for each of the 6 years of measurement. Similar $PM_{2.5}$ levels and $PM_{1/2.5}$ ratio were reported for a rural site in Northwest Spain (Salvador et al., 2006).

Spatial distributions show sulphate and carbon particle levels reaching maxima in industrialized areas and large cities (where traffic emissions are higher), and nitrate levels increase from the Atlantic to the Mediterranean (independent of the regional NOx emissions). African dust outbreaks have an influence on the number of exceedances of the daily limit value, additionally load on the mean annual PM_{10} levels ranges from 1-2 μg/m^3 in most areas of the Iberian Peninsula to 4-5 in the Canary and Balearic Islands and the southern ends of Iberia.. The marine aerosol contribution is near one order of magnitude higher in the Canaries and the Atlantic coast of Iberia compared to the Mediterranean regions. Important temporal influences include PM intrusion events from Africa (more abundant in February-March and spring-summer), regional scale pollution episodes, and weekday vs. weekend activity. Higher summer insolation enhances sulphate but depletes particulate nitrate (as a consequence of the thermal instability of ammonium nitrate in summer) and Cl^- (due to HCl volatilisation resulting from the interaction of gaseous HNO_3 with the marine NaCl), as well as generally increasing dry dust resuspension under a semi-arid climate.

Trace element concentrations in PM_{10} and $PM_{2.5}$ were determined at 33 monitoring stations in Spain throughout the period 1995-2006. Industrial emissions from different forms of metallurgy (steel, stainless steel, copper, zinc), ceramic and petrochemical industries were evaluated. Results obtained at sites with no significant industrial impact allowed us to define usual concentration ranges for a number of trace elements in rural and urban background environments. At industrial and traffic hotspots average trace metal concentrations were highest, exceeding rural background levels by even one order of magnitude in the cases of Cr, Mn, Cu, Zn, As, Sn, W, V, Ni, Cs and Pb. Steel production emissions were linked to high levels of Cr, Mn, Ni, Zn, Mo, Cd, Se and Sn (and probably Pb). Copper metallurgy areas showed high levels of As, Bi, Ga and Cu. Zinc metallurgy was characterised by high levels of Zn and Cd. Glazed ceramic production areas were linked to high levels of Zn, As, Se, Zr, Cs, Tl and Pb. High levels of Ni and V (in association) recorded at one site under the influence of heavy vessel traffic could be considered tracers (although not exclusively) of shipping emissions. Levels of Zn-Ba and Cu-Sb were relatively high in urban areas when compared with industrialised regions due to tyre and brake abrasion, respectively (Querol et al., 2007).

Source apportionment studies have been carried out in a lot of monitoring sites in Spain using mainly PCA and PMF tools, and CMB in a much lesser extend (Viana et al., 2007). The results from our studies show that, as expected, the contribution of the different sources is highly variable according to the type of sampling station. The results obtained at

the sites in the Iberian Peninsula are also very different from those obtained in the Canary Islands. Traffic contributions to PM_{10} levels at urban background stations in the Peninsula vary from 21 to 34% (6–15 μg/m^3), but may reach 48% (23 μg/m^3) at traffic sites. This contribution reaches only 5% (2 μg/m^3) at the urban background site in the Canaries. Traffic contributions attain 11–25% of the PM_{10} levels (3–5 μg/m^3) at the rural stations in the Iberian Peninsula. The industrial factor also exhibits important variations as a function of the study area. In the Peninsula, this contribution at urban background stations under industrial influence ranges from 20 to 44% (9–20 μg/m^3). At rural sites with industrial influence, these contributions account for 15–25% of the PM_{10} mass (3–6 μg/m^3). In the Canaries, industrial emissions only account for 10% of the PM_{10} mass (4.5 μg/m^3). This contribution is similar to that determined for the external anthropogenic emissions (10%). A detailed chemical and physical characterization of road and demolition dust is being carried out in around 25 sites in the city of Barcelona. This will allow to apply the CMB in this area in the near future.

The last part of this presentation summarizes results on the interpretation of the variability of number concentration of aerosols in an urban environment of Barcelona. Measurements are made up with a CPC since November 2003, but a DMA for grain size segregation was only used in 2003-2004. Two main atmospheric physical-chemical scenarios are frequently repeated and accounted for most of the variation observed in number concentrations and diameter. Details of these scenarios are presented.

Finally, a study on source apportionment study for number concentration (instead of PM mass) has been carried out with chemical speciation. The results are very interesting since this approach does not only allow quantifying the contribution of specific emission sources, but also from some atmospheric process, such as photochemical conversion.

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Particle –health effects from fundamental cellular lung-biology through cell-exposure systems to real-world diesel particle exposure

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Keywords: Cellular mechanisms, exposure to aerosols, oxidative stress, diesel exhaust, aerosol sampling, aerosol size distribution, aerosol-surface reactions, health effects of aerosols.

Exposure to particulate matter (PM), especially the fraction smaller than 2.5 μm ($PM_{2.5}$) is associated with increased cardiovascular and pulmonary morbidity and mortality. At the beginning of the pathophysiological response to PM is suggested to be oxidative stress to lung cells, which then leads to endothelial and platelet activation, upregulation of pro-inflammatory mediators, acute phase responses and increased formation of coagulation factors. Repeated induction of this pathway can lead to atherosclerosis progression, plaque instability, increased risk for plaque rupture, thrombosis and myocardial infarction, and ultimately death (Riediker et al. 2006). The entire chain of effects must be studied if one wants to understand how particles and their properties cause health effects. We investigated in three projects (1) cell-particle and cell-cell interaction, (2) the in-vitro cellular oxidative stress response to artificially exposed particles, and (3) the influence of particles' surface parameters on the level of biomarkers of oxidative stress in diesel particle exposed workers.

(1) We demonstrated with a cell culture model of the human epithelial airway wall (Rothen-Rutishauser et al., 2005) that dendritic cells extend processes between epithelial cells through the tight junctions to collect particles in the “luminal space” and to transport them through cytoplasmic processes between epithelial cells across the epithelium or to transmigrate through the epithelium to take up particles on the epithelial surface (Blank et al. 2007). Furthermore, dendritic cells interacted with particle-loaded macrophages on top of the epithelium and with other dendritic cells within or beneath the epithelium to take over particles. By comparing the cellular interplay of dendritic cells and macrophages across epithelial monolayers of different transepithelial electrical resistance, we found that more

dendritic cells were involved in particle uptake in A549 cultures showing a low transepithelial electrical resistance compared with dendritic cells in16HBE14o cultures showing a high transepithelial electrical resistance 10 min (23.9% versus 9.5%) and 4 h (42.1% versus 14.6%) after particle exposition. In contrast, the macrophages in A549 co-cultures showed a significantly lower involvement in particle uptake compared with 16HBE14o co-cultures 10 min (12.8% versus 42.8%) and 4 h (57.4% versus 82.7%) after particle exposition. Hence we postulate that the epithelial integrity influences the particle uptake by dendritic cells, and that these two cell types collaborate as sentinels against foreign particulate antigen by building a network of interacting (interdigitating) cytoplasmic processes (Blank et al. 2007).
From studies dealing with particle cell interactions it is known that fine particles behave differently from that of nanoparticles (NP) (Rothen-Rutishauser et al., 2006) and recently we have shown that a small fraction of TiO2 NP are rapidly transported from the airway lumen to the connective tissue and subsequently released into the systemic circulation (Mühlfeld et al., 2007a). Using the triple cell co-culture system we have then compared and quantified the entering of fine (1 mm) and nano-sized (0.078 mm) polystyrene particles by laser scanning microscopy. The quantitative distribution of the different particles among the different cell types was compared using a contingency table analysis as described by Mühlfeld et al. (2007a). We found that the number distribution of particles within the cell types was significantly different between fine and nano-sized particles suggesting different translocation characteristics. In addition, energy filtering transmission electron microscopy showed that the intracellular localization of nanoparticles depends on the particle material. Both particle size and material affect the cellular responses to particle exposure as measured by the generation of tumour necrosis factor-a (Rothen-Rutishauser et al., 2007).
(2) The chemical composition, surface chemistry and number of inhaled particles are likely important factors involved in adverse health effects associated with exposure to particles in the atmosphere. Therefore, aerosol characteristics should be carefully monitored and maintained in model systems to study the interaction of particles with the lung. In this project we investigate the interaction of fine and ultrafine organic particles with cellular and acellular lung components by ultrastructural, biochemical and physiological methods. The main focus is on oxidation properties of the particles. We developed an aerosol deposition chamber to expose lung-cell cultures to particles $\leq$ 1 mm in diameter, using a conditioned air-flow mimicking closely the particle deposition conditions in the lung (Savi et al., 2007). In this new deposition chamber particles are deposited in a controlled and standardized manner, highly efficient, reproducibly and very uniformly onto the entire cell culture, a key aspect if cell responses are quantified in respect of the deposited particle dose. Further advantages are short exposure times and the simultaneous exposure of 6 individual cell cultures. Recently, the exposure chamber has been equipped with a fibre optic to determine the ciliary beat frequency, indicative of the defence capability of the cells. Online analyses of the lung cells are complemented by off-line biochemical, physiological and morphological cell analyses. The suitability of the chamber for cells was successfully tested on lung epithelial cells and macrophages using (inert) particles of different sizes and materials (Lang et al., 2007; Savi et al., 2007). Moreover, the addition of the fibre optic allows us to measure cellular responses online, i.e. during aerosol exposure. The exposure of lung-epithelial cells and macrophages to inert particles in our newly developed particle deposition chamber has not yielded in loss of the cellular integrity or in increased cytotoxicity measured via lactate dehydrogenase. Furthermore the phagocytic activity of macrophages was not impaired. Recently, experiments with oxidized organic particles have been conducted (Geiser et al., 2007; Kalberer et al., 2007). Preliminary data indicate the induction of distinct cellular effects by these aerosols.

(3) Surface characteristics (chemical reactivity, surface area) are considered of prime importance to understand the mechanisms, which lead to harmful effects. A hypothetical

mechanism to explain these adverse effects of particulate matter is the ability of some components (organics, metal ions) adsorbed on these particles to generate reactive oxygen species (ROS), and thereby to cause oxidative stress in biological systems (Donaldson et al., 2003). ROS can attack almost any cellular structure, like DNA or cellular membrane, leading to the formation of a wide variety of degradation products, which can be used as a biomarker of oxidative stress. The aim of this third research project was to investigate the association between the exposure to Diesel Exhaust Particulate (DEP) and the oxidative stress status. For that purpose, a survey was conducted in real occupational situations where workers are exposed to DEP (bus depots). Several biomarkers of oxidative stress (8-hydroxy-2'-deoxyguanosine and several aldehydes) were determined either in urine or serum of volunteers, and levels will be discussed in relation to exposure variables. In order to bring some insight into the relation between the particulate surface characteristics and the formation of ROS by-products, different exposure variables have been considered: a) particulate number, size distribution and surface (measured with a scanning mobility particle sizer SMPS); b) particulate mass - PM2.5 and PM4 (gravimetry); c) elemental and organic carbon (coulometry); d) total adsorbed heavy metals - iron, copper, manganese (atomic adsorption); e) surface functional groups present on aerosols (Knudsen flow reactor). (Demirdjian et al., 2005)
Results obtained during the sampling campaign in several bus depots indicated that occupational exposure to particulate is rather low. Size distributions indicated that particles are within the nanometric range. Surface characteristics of sampled particles were very different, depending on the bus depot. They were usually characterized by high carbonyl and low acidic sites content. Mean urinary levels of 8-hydroxy-2'-deoxyguanosine increased significantly during two consecutive days of exposure for non-smokers.

In conclusion, these three interlinked projects showed that particles are transported in the lungs in a complex cell-cell-particle interplay and that once cells are exposed to particles in an aerosol deposition chamber, they show distinct cellular effects. Finally, a system to assess the particle surface characteristics of real-world particles was established and is currently being tested in a cohort of diesel-exposed workers. The results of these three projects not only demonstrate the chain of effects from exposure to the manifestation of health effects, but they will also suggest measurement and biological parameters that could be useful for epidemiological studies and thus provide a more complete understanding of how particle properties eventually lead to the observed health outcomes.

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Size resolved characterization of atmospheric PM at suburban site of Prague

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Keywords: PM_x, Ionic composition, Urban aerosol

PM10, PM2,5, and PM1 fractions of particulate matter were studied in Prague during year 2006, to get more information about content of secondary aerosol particles in PM10 fraction of suspended particles. Current models used in the Czech Republic are counting with primary emissions emitted from urban and natural sources and do not comprise production of secondary aerosol and reemission of resuspended particles. Secondary aerosol particles are formed by chemical reaction of gaseous precursors followed by condensation of product. Those particles are mainly included in fine mode of PM10 fraction, which is mostly retained inside respiratory system.

EXPERIMENTAL

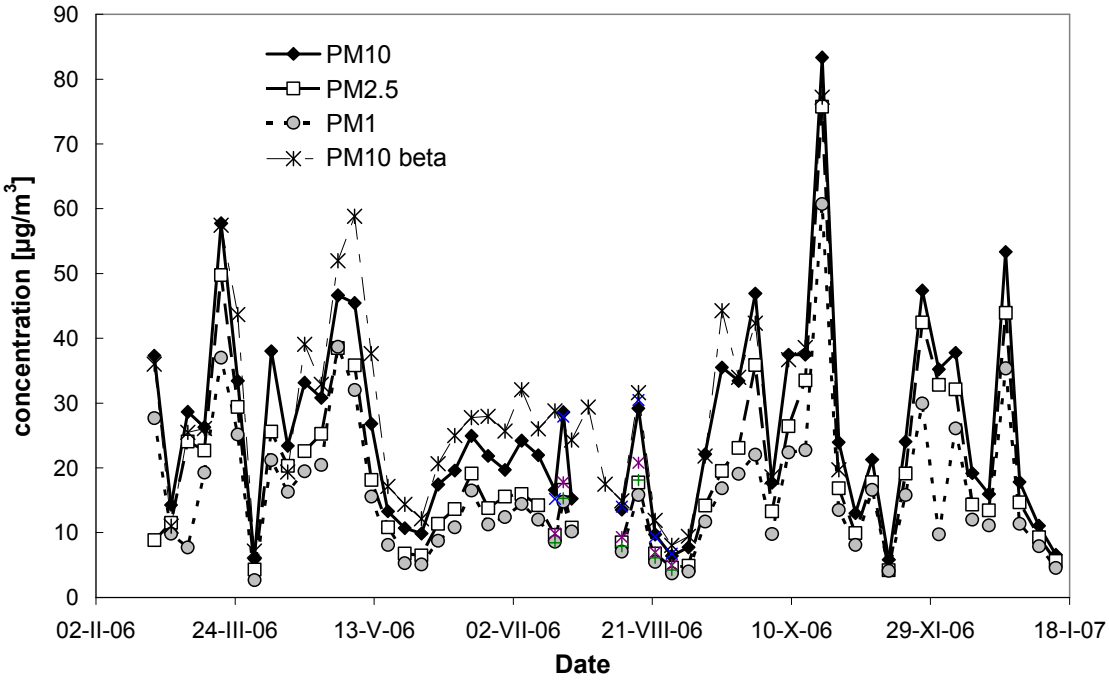

Fig. 1: Time series of PM10, PM2.5 and PM1 and PM10 determined by regular monitoring station at Suchdol

Samples of atmospheric particles were collected on the roof site located 285 m ASL at the northwest part of Prague (see Figure 1) in the campus of the Institute of Chemical Process and Fundamentals. PM10, PM2.5 and PM1 fractions were sampled for 24 hours every 6th day during whole year 2006. Particles collection was provided by using PM10 and PM2.5 sampling heads (Leckel) and PM1 cyclone sampling head (URG) with flow rate 1 m^3 per hour. Total flow rate through filters was measured by gas meter located downstream with membrane pump for ambient air sampling. Zefluor Teflon filters with 2 µm pore size and 47 mm in diameter (Pall, USA) were used to collect aerosol particles. In parallel, Leckel LVS3 sampler with PM2.5 sampling head was used to collect PM2.5 size fraction on quartz filter

(QMA Whatmann). Aerosol mass was determined by gravimetric analysis using a microbalance Sartorius with 1 µg sensitivity. The samples were extracted 1 hour using a shaker by mixture of 0,5 ml of methanol and 4,5 ml of Ultrapure water. (Ultrapur, Watrex Ltd.) The filtered sample was than analyzed for anion and next day for cations. The sample solutions for cation analysis were stored in the fridge prior to analysis. The chlorides Cl^-, nitrites NO_2^-, nitrates NO_3^-, and sulfates SO_4^{2-}, were analyzed as main anions and Na^+, NH_4^+, K^+, Zn^{2+}, Mg^{2+} and Ca^{2+} as main cations. The analysis were provided by using the setup by Watrex Ltd. with columns Transgenomic ICSep AN300 150x5,5 mm for anions and Alltech universal cation 7µm 100x4,6 mm for cations. The conductivity detector used in the setup was SHODEX CD-5

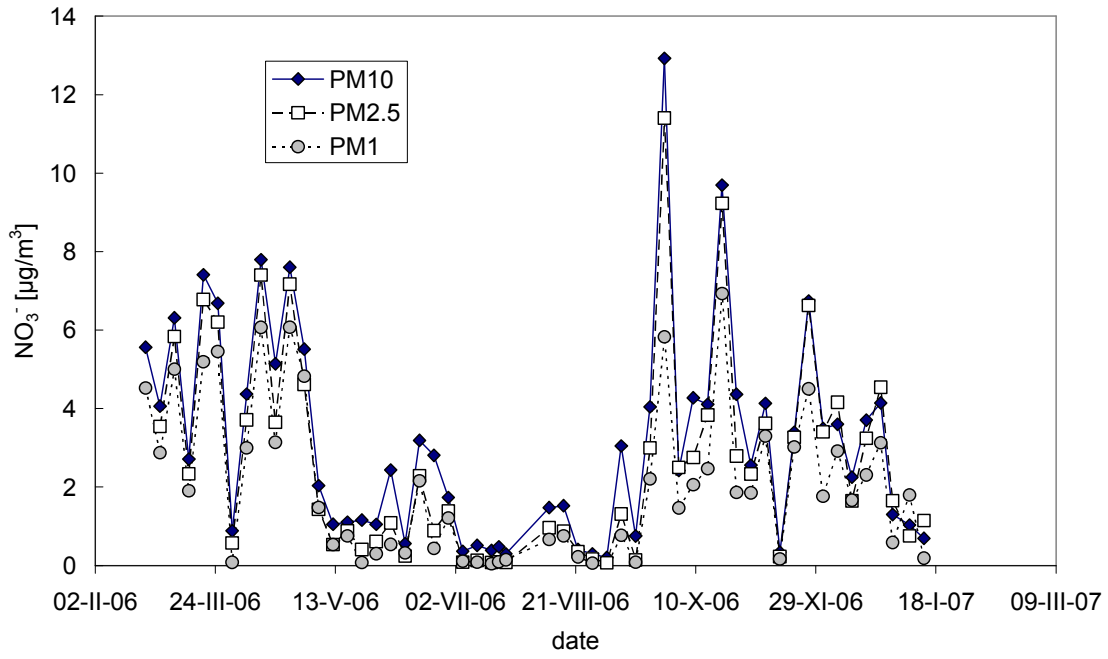

Fig. 2: Time series of particulate NO_3^- ion concentration in PM10, PM2.5 and PM1 size fractions

RESULTS

Results of PM10, PM2.5, PM1 fractions obtained during year 2006 are shown in the Figure 1. Average mass concentrations were (26,9±14,9) µg/m3 for PM10, (20,3±13,5) µg/m3 for PM2.5, (16,4±10,8) µg/m3 for PM1 fractions. These values are in the range commonly measured in Prague and elsewhere in Central and Western Europe (e.g. Van Dingenen et al. (2004), Schwarz et al., (2006)). The ratios PM2,5 to PM10 are higher in winter then in summer and generally they are very high. In the opposite PM1 to PM2,5 ratio is slightly higher for summer probably due to lower average humidity, which shift accumulation mode to the smaller particles.

Chemical analysis of ionic fraction showed high importance of secondary inorganic ionic fraction especially for fine fraction. Sulfates, nitrates and ammonium formed together 40% of PM2.5 mass. While sulfates and ammonium were almost completely in PM2.5 size fraction, nitrates were partially in coarse fraction, especially in summer, when high temperatures lead to decomposition of ammonium nitrate both in atmosphere and on the filter. Calcium and magnesium were found mainly in coarse size fraction, potassium cation exhibits similar behavior like nitrates being mostly in fine fraction in winter and partially in coarse size fraction in summer, probably due to higher resuspension. Some, but exceptional influence of sea salt particles was observed.

CONCLUSIONS

The fine fractions (PM2.5 and PM1) form most of PM10 size fractions in Prague area especially during winter period when most of exceedances happened. Secondary inorganic ions are one of most important fractions in Prague forming together 40 % of PM2.5 mass. Therefore all strategies to mitigate aerosol burden should include their gaseous precursors.

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Black Smoke is a good proxy for Black Carbon

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Keywords: Black Smoke, Black Carbon, Trend

In Working Group I of COST633 an assessment is made of changes in aerosol characteristics in Europe. An aerosol parameter that exhibited quite a drastic change in the past fifty years is “Black Smoke”. We show in our contribution that Black Smoke is a good measure for Black Carbon and thus for assessing the historical trend in Black Carbon.

Black Smoke has been in use as a proxy for aerosol mass, because the measuring principle is much simpler than the weighing of filters. The basis procedure for Black Smoke is based on the blackness (darkness) of an aerosol filter sample. The blackness is the difference in the light reflected by a loaded filter compared to that of an unloaded filter. The measurements are done according to a protocol dating back to 1964 (OECD, 1964). In that protocol the definition of Black Smoke is also provided. It is based on reference measurements and defined as equivalent to the **amount** of aerosol in a filter of a given blackness.

Black Smoke has little value as a measure of total aerosol, because its concentration may grossly differ from that of the actual mass concentration (Bailey and Clayton, 1982). The explanation lies in the measuring principle: samples containing a higher proportion of light-absorbing material than the reference samples are categorised as having a much higher total aerosol mass and vice versa. However, it has been appreciated by the epidemiological community that the parameter Black Smoke is a good proxy measure for the light-absorbing material produced by heavy traffic (Hoek et al., 1995).

The light-absorbing material in aerosol in Europe is almost exclusively Black Carbon. The parameter is used as a proxy for “soot”. Black Carbon is (also) determined from the amount of light absorbed by aerosol filter samples. This implies that the optical data in the measurements of the two parameters should be comparable, which would open the way to translate Black Smoke data into Black Carbon values.

We were aware, through literature, of a number of campaigns in which Black Carbon and Black Smoke were simultaneously measured. We were allowed access to the original data of these campaigns, see acknowledgments. The campaigns analysed here cover a total of over two years of measurements, with the brunt of the information stemming from studies by Petzold and Niessner at a number of sites in Germany. Contrary to expectations, the amount of light absorbed by the same aerosol in the two methods did not correlate well. However, we did find a very good linear regression between the concentrations of Black Smoke and Black Carbon, see e.g., Figure 1. It is a surprise that Black Smoke and Black Carbon correlate so well, because both are derived parameters.

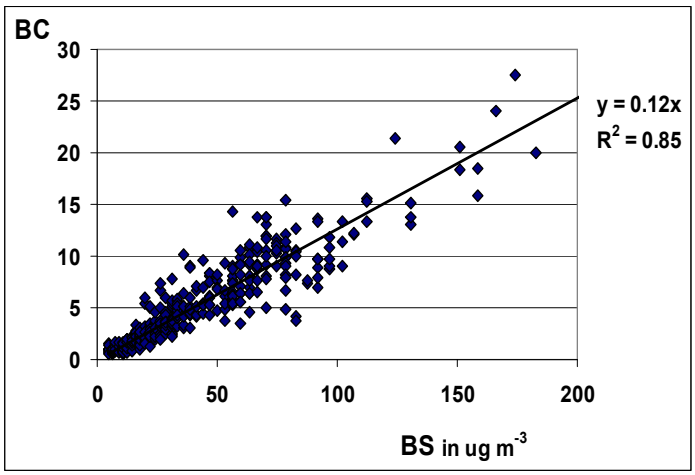

Figure 1: Scatter plot of the data obtained from Dr. Petzold. **BS** stands for Black Smoke and **BC** for Black Carbon (also in the unit ug m^{-3}).

The explanation for the fact that the optical parameters do not correlate well is that both the Black Carbon and the Black Smoke measurement suffer from a so-called shadowing effect. This is the phenomenon that aerosol particles are preferentially collected on deposited particles during filtration. A particle that is sampled on top of other particles absorbs most of the light and the underlying particles then are in its shadow. This leads to a highly non-linear relation between the amount of light absorbed and sample loading.

It turns out that the shadowing effect is corrected for in the translation of the amount of light absorbed to concentration for both Black Smoke and Black Carbon. For Black Carbon the non-linearity effect is averaged out by the frequent renewal of the sampling filter.

The shadowing effect in the Black Smoke method is accounted as can be appreciated from the original work in the earlier reference tests. In those experiments sample load and the associated the amount of light absorbed were related via samples containing different loadings of the same aerosol. These samples were produced via a collection with a series of parallel filters that were sampling with different time intervals. The standard OECD-curve with which blackness is translated into Black Smoke is based on those measurements. It is concluded here that, in hindsight, the OECD-curve very appropriately accounts for the shadowing effect.

While Black Smoke appears to be an ill defined parameter, also Black Carbon is not well defined. The unit for Black Carbon was set some 25 years ago by relating the amount of "Elemental Carbon" with the blackness. A number of extended campaigns have shown that there is large ambiguity in the value of Elemental Carbon, depending on the measuring method. For this reason the parameter Black Smoke is very likely as good a proxy for the amount of light-absorbing carbon, respectively "soot" as Black Carbon.

Finally we discuss another feature of the Black Smoke method. We deduce this from data in the paper by Bailey and Clayton (1982). The graphs relating blackness and loading are seen to differ only by a multiplication factor, which most likely represents the fraction of Black Carbon in the samples. This indicates that the shadowing effect does not depend on aerosol type. In contrast, in the Black Carbon measurements the mentioned shadowing effect depends on the fraction of other material present in the aerosol (Weingartner et al., 2005). This could imply that the Black Smoke method is more universal for assessing the amount of soot.

Acknowledgements:
The author is especially grateful for the long data-set made available by Dr. Andreas Petzold (DLR). Access to the data of Dr. Edward Roekens (VMM, Antwerp, Belgium) and Edith van Putten (RIVM, Bilthoven, the Netherlands) is also kindly acknowledged.

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Chemical characterization of particulate matter and insight into the source apportionment in Slovenia

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Keywords: urban aerosols, chemical composition, source identification, combustion aerosols

The most problematic area regarding air quality in Slovenia is pollution with particulate matter. Several reports revealed significant correlation between particulate matter levels and adverse effects on human health (Pope, 2000). Atmospheric aerosols in urban areas are complex mixtures of substances of different physico-chemical properties and origins - natural or anthropogenic (Mészáros, 1999). Understanding of chemical composition and source apportionment is of great importance for controlling air pollution in these areas. Important contributions are generally from traffic, different industrial activities, resuspension of soil, primary and secondary organic emissions and long range transport. Among the industrial combustion sources that have significant relative contribution to air pollution are also power plants (Xu *et al.,* 2003).

The aim of this contribution is to present results of the monitoring of particulate matter in Slovenia between 2004 and 2007. More detailed information about the nature of particles was obtained from several short term campaigns, which were focused on mass size distributions and detailed chemical analysis. In addition, investigation of mass and chemical size distribution of particles emitted from the stack of the largest thermo-power plant in Slovenia was performed and compared to results obtained in the surrounding of this source.

Monitoring of PM10 in Slovenia is performed at seven different locations by Environmental Agency of the Republic of Slovenia. Continuous measurements are performed by TEOM (Tampered Element Oscillating Microbalance), while 24-hours measurements are done by reference samplers (Leckel) according to European standard (EN12341). In table 1 average yearly concentration of PM10 and number of days above the 24-hour limit value (50 $\mu g\ m^{-3}$) in 2006 are presented.

Table 1: Average yearly concentration of PM10 and number of exceedences of limit value (50 $\mu g\ m^{-3}$) in 2006 Ljubljana, Maribor, Trbovlje and Iskrba.

	Average yearly concentration [$\mu g\ m^{-3}$]	Number of exceedences of limit value
Ljubljana	36	51
Maribor	45	117
Trbovlje	42	92
Iskrba	14	3

Study on size segregated sampling and subsequent analysis of water soluble part was carried out at in 2004 and 2005. Locations ranged from urban traffic locations (Maribor and Trbovlje), urban background locations (Ljubljana and Nova Gorica), rural location (Murska Sobota) to regional background location (Iskrba) Measurements were done in winter and summer period. Sampling was performed by Berner low-pressure cascade impactors with 10 collection stages in the size ranges from 15 nm to 16 μm. Combined samples were prepared from impactor foils, closely matching sizes of the ultrafine particles, accumulation particles and coarse particles. Chemical analysis was focused on water soluble part. Results showed that the highest concentrations of PM10 particles were measured at urban-traffic locations (Trbovlje and Maribor), followed by urban background location (Ljubljana). Because of additional emissions due to heating and unfavorable meteorological conditions in basins, higher concentrations of particles were observed in winter months. At all locations the accumulation mode was the most pronounced. The fraction of coarse particles was at all measuring sites higher in summer time. However, the most pronounced difference between two periods was observed for both background locations. Concentrations of SO_4^{2-} were comparable in both seasons, while concentrations of NO_3^- and NH_4^+ were lower in summer due to the losses of NH_4NO_3 during sampling. Concentrations of ions in the coarse mode varied depending on location and season. Because of salting higher concentrations of Na^+ and Cl^- were observed in winter. In comparison to other locations, higher concentration of Ca^{2+} in Trbovlje were observed, which are connected to the vicinity of cement factory. Concentrations of the most analyzed trace metals were lower in summer time.

Detailed chemical composition PM10 particles was performed at four locations – Ljubljana (urban background location), Maribor (traffic location), Trbovlje (predominant influence of traffic and a cement industry) and Iskrba (regional background locations) in winter and summer 2007. Filters were divided into sub-samples and analyze for the content of major ions (ion chromatography), selected trace elements (ICP-MS after digestion by HNO_3 and H_2O_2) and total and elemental carbon (thermo-optical method). PM10 concentrations at background location were for about 30 % lower comparing to concentrations measured at all three urban locations. The highest fraction of secondary inorganic compounds (NH_4^+, NO_3^-, SO_4^{2-}) was observed at regional background site. Higher concentrations of V at Maribor are connected to emissions from traffic, while higher concentrations of Tl, as well as Ca, Al and SO_4^{2-} at Trbovlje show influence of cement industry.

Measurements of size-segregated particles at the stack of thermo power plant were carried by especially designed sampling system. The central part was cascade impactor, which was positioned outside the chimney stack. Arrangement with both Tedlar and aluminium foils at the same time enabled simultaneous determination of mass and chemical size distribution with one impactor. Determination of some major compound and trace elements was done after extraction with concentrated HNO_3, while analysis SO_4^{2-} was performed after extraction with water. The results of mass and SO_4^{2-} size distribution of particles collected at the stack of the thermo-power plant during sampling in 2005 are shown in Figure 1.

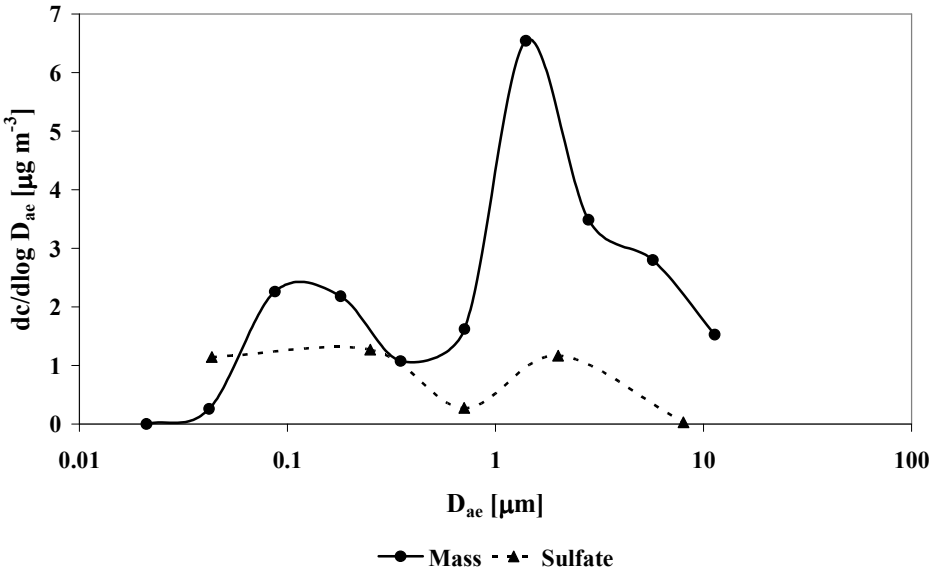

Figure 1: Mass and sulfate size distribution of particles collected at the stack of thermo power plant Šoštanj. (T = 104 ^{o}C).

Mass size distributions were generally bimodal, with the most pronounced mass peak in the size range between 1 and 2 µm. The second mass peak was noticed in the range of 0.06 - 0.25 µm. The prevailing compound in all size fractions was SO_4^{2-}. The highest concentrations for the most analyzed compounds (Mg, Al, K, Ca, Sr, Fe, V, Mn, Co, Zn, Ga, As, Mo, Cd and Pb) were observed in the size fraction between 1 and 4 µm. Sulfate and Se exhibited bimodal distribution with first peak in the size range between 125 and 500 nm and second in the range 1 to 4 µm. Results on elemental mass size distributions showed differences in comparison to the most common ambient anthropogenic sources (i.e. traffic emissions). Thus, mass size distributions of certain elements can be used for as a useful tool for source identification

Acknowledgements: The financial support of the Ministry for Higher Education and Science and of the Ministry for Environment and Spatial Planning of the Republic of Slovenia is gratefully acknowledged.

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SOURCE APPORTIONMENT OF PM10 IN COPENHAGEN URBAN BACKGROUND

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Keywords: Mass closure problem, COPREM, health effects.

PM in urban background is a mixture of many different components originating from various sources, with local and regional variation, affecting its toxicity. Knowledge about which sources of PM are most relevant in determining health effects remains limited. For targeted prevention of PM associated health effects, identification of the most relevant sources is required and data are urgently needed.

Particle data were measured by the Danish National Environmental Research Institute (NERI) at the fixed roof (20 m above the ground) urban background monitoring station (HCOE) located in the centre of Copenhagen. Daily (24 h, midnight-to-midnight) mean concentrations were available for PM10, measured by SM200 monitor. Data from HCOE station were not sufficiently comprehensive for a complete source apportionment of PM10. This is due to monitoring networks in Denmark focusing on the local sources at urban sites, and on the long-range sources at the rural site, resulting in inorganic ions being measured only at the rural monitoring station. Thus additional data consisting of daily samples for total suspended particulates (TSP) from a forest rural station (Frederiksborg, 3 m above the ground) 35 km NNW of central Copenhagen were necessary for a source apportionment of PM10. These samples from HCOE and Frederiksborg (03.05.2002-22.12.2003) were analyzed for elements and ions using proton induced x-ray emission (PIXE), ion chromatography, automated colorimatry, and atomic absorption spectrophotometry encompassing the elements Al, Si, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Zr, Mo, Sn, Sb and Pb, and ion analyses encompassed Na+, Mg2+, NH4+, Cl-, SO42-, and NO3-. The chemical analysis was performed at Department of Atmospheric Environment at NERI.

We used the constrained physical receptor model (COPREM) to apportion PM10 between different sources. COPREM is a hybrid model unifying Chemical Mass Balance (CMB) modelling and non-negative factor analysis. The details of COPREM software are published previously (Wåhlin, 2003). The initial fixed source profiles included road dust, direct vehicle emissions (exhaust and brake dust), sea salt, converted sea salt ($NaNO_3$), two soil profiles, NH_4NO_3, $(NH_4)HSO4$, and $(NH_4)_2SO_4$. The road dust profile (including dust due to tyre wear) and direct vehicle profile were determined from a study of PM10 road increments at a busy street in Copenhagen (Wåhlin *et al*., 2006), and the profiles were used under the assumption that the road increments measured in the street are representative for the general traffic emissions in the city background. The soil contributions (beyond what can be explained by the road dust source) were fitted using two representative profiles, one with the composition of igneous rock, the other with the composition of limestone. The COPREM profiles for the ammonium sources were calculated according to the stoichiometric content, while the sea salt source profiles were calculated according to the average composition of sea water. Only about the half of the PM10 could be explained by well-defined initial source profiles in COPREM. Unexplained enriched concentrations of some elements were considered tracers for different combustion sources not accounted for initially. These included biomass combustion (K), fuel oil combustion (V and Ni), and coal combustion/incineration (Zn, Se, and Pb), which represented probably several sources, but without additional measurements of organic compounds it was not possible to make better differentiation. Therefore, in COPREM, elements K, V and Se were chosen as tracers for the 'Biomass', 'Oil' and 'Coal' in the following way: V and Se were not allowed in 'Biomass', K and Se were not allowed in 'Oil', and K and V were not allowed in 'Coal'. The PM and the other elements in the 'Biomass', 'Oil' and 'Coal' profiles were allowed to adapt freely to the data in the non-negative range. The result of the fit for PM10 is shown in Table 1.

Table 1. Result of source apportionment.

Source	PM10 (μgm^{-3})
Road	1.2
Vehicle	0.8
Salt	1.3
Biomass	7.5
Oil	3.6
Coal	0.0
Rock	0.8
Lime	0.5
$NaNO_3$	0.9
NH_4NO_3	3.3
$(NH_4)_2SO_4$	2.6
$(NH_4)HSO_4$	0.9
Sum	23.3
Measured	23.9

A large fraction of the measured PM10 in urban background can be explained by well-defined, mostly inorganic, sources. Nevertheless, almost 50% of the mass needs to be explained by other sources. Biomass burning seems to be a so far underestimated source of PM in Europe. In a similar study in Danish rural background in the summer 2002 high concentrations of PM10 can be directly linked to wildfires in Russia and Belarus.

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APPENDIX III

Abstracts of Conferences, Special Sessions and Public Workshops

The Abstracts from the 2006 conference were published in the Scientific Report of the Conference and are not included here. For the COST 633 Public Workshop in March 2008 in Brussels, all presentations are available at the Action website.

Part A) COST 633 Public Conference, May 2007, Lausanne

Part B) COST 633 Special Session at the European Aerosol Conference, September 2007, Salzburg

Part C) Public Workshop, COST 633, Brussels, March 13-14, 2008

Part A) Public Conference "Particles and Health – State of the Research and Policy Implications", Lausanne, May 16, 2007

Particles and Health

– State of the Research and Policy Implications –

Public Conference

Wednesday, May 16, 2007

Auditoire Alexandre Yersin, University Hospital Center, Lausanne

9:30 – 15: 30 Researchers present the state of the research in Europe

16:00 – 17:30 Policy makers and researchers discuss the policy implications

Organizers:	**Dr. Michael Riediker, IST Lausanne, Switzerland** [1)]
	Prof. Dr. Regina Hitzenberger, University of Vienna, Austria [2)]
Registration:	**There is no entry fee. Registration is only required for speakers and poster presenters.**
Sponsor:	**The European COST office in Brussels kindly provides funding for this event.**

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Programme

08:30-09:30	**Coffee and registration**
09:30-09:35	**Welcome and opening remarks** ***Michael Riediker**, IST Lausanne, Switzerland*

Research about particles and health in Switzerland

9:35 – 10:00	**Keynote: Research about particles and health in Switzerland** ***Ursula Ackermann-Liebrich*** *Chair Swiss Federal Commission for Air Hygiene* *Academic Director, "Swiss School of Public Health + ", Basel, Switzerland*
10:00 – 10:20	**Assessment of Diesel exhaust particulate exposure and surface characteristics in association with levels of oxidative stress biomarkers** ***Jean-Jacques Sauvain**[1], A. Setyan[1], M. Riediker[1], M. J. Rossi[2], M. Guillemin[1]* *[1] Institute for Occupational Health Sciences, Lausanne, Switzerland* *[2] Air and Soil Pollution Laboratory, EPFL, Lausanne, Switzerland*
10:20 – 10:40	**Translocation of particles, effects, and cellular interplay after exposure to fine particles and nanoparticles in an epithelial airway model.** *P. Gehr, B. Rothen-Rutishauser, C. Mühlfeld and **Fabian Blank*** *Institute of Anatomy, University of Bern, Bern, Switzerland*
10:40 – 10:50	***Short break***
10:50 – 11:10	**Searching for the mechanisms of interaction between nanoparticles and lung-cells** ***Markus Kalberer**[1]*, **Marianne Geiser**[2]*, M. Savi[2], D. Lang[2], A. Gaschen[1], M. Fierz[3], M. Ryser[4], J. Ricka[4]* *[1] Department of Chemistry and Applied Biosciences, ETH Zurich, Switzerland* *[2] Institute of Anatomy, University of Bern, Bern, Switzerland* *[3] Institute for Aerosol- and Sensor Technology, FHNW, Windisch, Switzerland* *[4] Institute of Applied Physics, University of Bern, Bern, Switzerland*
11:10 – 11:30	**Assessing long-term exposure to traffic-related air pollution in a large Swiss Cohort (SAPALDIA)** ***L-J Sally Liu,** D. Keidel, A. Gemperli, M. Hazenkamp, Ch. Schindler, and the SAPALAIDA team.* *Institute of Social & Preventive Medicine, University of Basel, Switzerland*
11:30 – 11:50	**Health effects of air pollution in a large Swiss Cohort (SAPALDIA)** ***Thierry Rochat** [1], L.-J. S. Liu, S. Downs, E. Zemp, L. Bayer-Oglesby, D. Felber Dietrich, M.W. Gerbase, J.M. Gaspoz, N. Probst-Hensch, U. Ackermann-Liebrich, P. Leuenberger, Ch. Schindler, and the SAPALADIA team.* *[1] Pulmonary Division, University Hospitals of Geneva, Switzerland*
11:50 – 12:55	***Sandwich lunch and poster viewing***

Intermezzo: The petroleum industry perspective

12:55 – 13:15 **Research needs for Health Effects of Air Pollution – CONCAWE recommendations for FP7**

Jan Urbanus
CONCAWE, the oil companies' European organisation for environment, health and safety, Brussels, Belgium

Research about particles and health in Europe and worldwide

13:15 – 13:35 **Overview on the activities of COST633 Working Group 3: source apportionment methods EU**

Mar Viana[1]*, *X. Querol*[1], *T.A.J. Kuhlbusch*[2], *A. Miranda*[3], *M. Vallius*[4], *A. Kasper-Giebl*[5], *S. Szidat*[6], *W. Winiwarter*[7], *R.M. Harrison*[8]
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[2] *IUTA e.V. Duisburg, Germany*
[3] *University of Aveiro, Aveiro. Portugal*
[4] *National Public Health Institute, Kuopio, Finland*
[5] *Institute for Chemical Technologies and Analytics, Vienna, Austria*
[6] *University of Bern, Bern, Switzerland*
[7] *Austrian Research Centers, Vienna, Austria*
[8] *The University of Birmingham, Birmingham, United Kingdom*

13:35 – 13:55 **Release of particulate material into the atmosphere: quality considerations of PM emission inventories**

Wilfried Winiwarter
Austrian Research Centers – ARC, Vienna, Austria

13:55 – 14:15 **PM and NO_2 at urban sites with different traffic exposure: Curb site measurements in Flemish cities**

M. Van Poppel[1], *E. De Dekker*[2], *L. Int Panis*[1], *N. Bleux*[1], *M. Spruyt*[1] *and* ***Patrick Berghmans***[1]
[1] *VITO, Flemish Institute for Technological Research, Belgium*
[2] *Environmental Department – City of Ghent, Belgium*

14:15 – 14:25 ***Short break***

Research about particles and health in Europe and worldwide *(Continued)*

14:25 – 14:45 **Formation of sulphate in concentrated solutions of salts**

Axel Berner*[1]*, *J. Turšič*[2] *and R. Hitzenberger*[1]
[1] *Experimentalphysik, Fakultät für Physik, Universität Wien, Vienna, Austria*
[2] *National Institute of Chemistry, Ljubljana, Slovenia.*

14:45 – 15:05 **Size partitioning of airborne particles to compare their proinflammatory effect in airway epithelial cells**

Armelle Baeza-Squiban*[1]*, *K. Ramgolam*[1]*, O. Favez*[2]*, L. Martinon*[3]*, H. Cachier*[2]*, A. Person*[4]*, A. Gaudichet*[5]*, F. Marano*[1]
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[4] *Laboratoire d'Hygiène de la Ville de Paris, Paris, France*
[5] *Laboratoire Interuniversitaire des Systèmes Atmosphériques, Université Paris 12, Créteil, France*

15:05 – 15:30 **Keynote: Particles and Health in Europe**

Matti Jantunen
KTL-Environmental Health, Kuopio, Finland

15:30 – 16:00 ***Coffee break and poster viewing***

Health effects of particles - the policy makers' perspective

16:00 – 16:30 **Short statements by policy makers:**

Andrej Kobe, EU Commission, DG Environment (CAFE Team) *Note: Dr. Kobe cannot attend due to other obligations. Thomas Kuhlbusch, IUTA Duisburg will present his statement.*

Luc Recordon, National Councilor, Green Party, Lausanne, Switzerland

16:30 – 17:30 **Podium discussion: Implications for policy and research**

- What are the policy implications of the current research
- What are the research needs from the policy makers' perspective
- How can research better be integrated into the policy making processes

Participants (in alphabetical order):

Ursula Ackermann, Prof.
Chair Swiss Federal Commission for Air Hygiene
Academic Director, "Swiss School of Public Health + ", Basel, Switzerland

Peter Gehr, Prof.
Director, Institute for Anatomy
University of Bern, Bern, Switzerland

Matti Jantunen, Prof.
National Public Health Institute
Department of Environmental Hygiene, Kuopio, Finland

Luc Recordon, National Councilor and Lawyer
Representative of the Canton Vaud, Green Party, Lausanne, Switzerland

Jan Urbanus, Technical Coordinator
CONCAWE, the oil companies' European organisation for Environmental and Health Protection, Brussels, Belgium

Moderator: Michael Riediker

17:30 – 18:30 ***Apéro***

19:00 – 22:00 ***Dinner for invited guests***

Poster presentations (listed alphabetically by presenting author):

PM and NO_2 at urban sites with different traffic exposure: curb site measurements in Flemish cities

M. Van Poppel[1], E. De Dekker[2], L. Int Panis[1], N. Bleux[1], M. Spruyt[1] and ***Patrick Berghmans[1]***
[1] VITO, Flemish Institute for Technological Research, Belgium
[2] Environmental Department – City of Ghent, Belgium

A field campaign to assess air pollution effects on school children health

C. Borrego[1], J. Ferreira[1], M. Lopes[1], J. Valente[1], N. Neuparth[2], A.I. Miranda[1] and T. Nunes[1]
[1] Department of Environment and Planning, University of Aveiro, 3810-193, Aveiro, Portugal
[2] Faculty of Medical Sciences, New University of Lisbon, Lisbon, Portugal

Particulate air pollution exposure assessment in urban areas

C. Borrego[1], O. Tchepel[2], A.M. Costa[1], H. Martins[1], J. Ferreira[1] and A.I. Miranda[1]
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Generation and analysis of oxidizing model aerosols used in investigations of cell responses to nanoparticle deposition

Annina Gaschen*, M. Kalberer*
Department of Chemistry and Applied Biosciences, ETH Zurich, Zurich, Switzerland

Relationship between ambient air pollution and daily mortality in the urban area of Katowice – comparison on two periods 1994-1995 and 2001-2002

Malgorzata Kowalska[1]*, J.E.Zejda[1], L. Ośródka[2] , K. Klejnowski[3], E. Krajny[2], M. Wojtylak[2]*
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[2] Institute of Meteorology and Water Management, Katowice, Poland
[3] Institute of Environmental Engineering Bases of PAS, Department of Air Protection, Zabrze, Poland

Modelling particulate matter in European COST633 Action member states

A. I. Miranda[1], J. Ferreira[1], C. Borrego[1], T. Kuhlbusch[2], M. Viana[3,4], W. Winiwarter[5] and M. Ketzel[6]
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Size partitioning of airborne particles to compare their proinflammatory effect in airway epithelial cells

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K. Ramgolam{ XE "Ramgolam" }[1], O. Favez{ XE "Favez" }[2], L. Martinon{ XE "Martinon" }[3], H. Cachier{ XE "Cachier" }[2], A. Person{ XE "Person" }[4], A. Gaudichet{ XE "Gaudichet" }[5], F. Marano{ XE "Marano" }[1] :

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Keywords: urban aerosols, fine and ultrafine fractions, lung-particle interactions, health effects of aerosols

Paris background aerosol is almost exclusively composed of fine (PM 2.5; PM 1) and ultra fine (PM 0.1) particles, originating mainly from combustion processes including traffic exhausts. Epidemiological and experimental investigations underlined the role of the aerosol size, in particular the ultra fine one.

The aim of the present study was to investigate which size-fraction of the urban particulate matter is the most relevant regarding to the biological effect considering the proinflammatory response of airway epithelial cells *in vitro*. This response is characterized by the release of mediators that would explains the inflammation observed in exposed subjects.

Human bronchial epithelial cells (16HBE) and primary cultures of nasal epithelial cells (HNE) that are the main target cells of airborne particles were exposed to the different size-fractions. The release of GM-CSF, a cytokine involved in allergic process was used as a proinflammatory biomarker of PM exposure and the cytochrome P450 1A1 (CYP1A1) that metabolizes xenobiotics, which activity was used as a biomarker of polyaromatic hydrocarbon (PAH) bioavailability.

Downtown Paris, four co-located 13-stage Dekati cascade impactors running in parallel were used to selectively collect particles from 30nm to 10µm on polycarbonate filters and were allocated to biological and physico-chemical (black carbon, particulate organic matter and water soluble organic compounds, major ions, PAH) investigations. 11 samplings were conducted in order to investigate whether the seasonal variability (summer and winter) and diurnal evolution related to photochemistry of the urban aerosol composition modulate the biological effects of some or all size-fractions.

In vitro biological assays were conducted with particles from pooled stages (1 to 3 representing ultra fine fraction [0.1-0.03µm], 4 to 7 the [1-0.1µm], 8 to 9 the [2.5-1µm] fine fraction and 10 to 13 the [10-2.5µm] coarse fraction). Particles were recovered from collection filters by brief sonications directly in the same volume of cell culture medium for each size-fractions. Two experimental strategies were used: cells were exposed for 24 hours either at isovolume of particles suspension in order to respect the proportion of the different size-fraction in the sampled-air volume or at isomass.

When cells are exposed to an isovolume of particles suspension, the highest GM-CSF secretion was induced by PM1-0.1 that is the most important fraction in Paris background

aerosol (up to 71% of the total PM10 mass). With a cell exposure at an isomass of particles, GM-CSF secretion was significantly induced by fine and ultra-fine particles with a dose-dependent increase from 1µg/cm² (5µg/mL) to 10µg/cm², without inducing any cytotoxicity. Whatever the season or diurnal sampling, the finer the aerosol fraction, the higher the GM-CSF secretion was, whereas coarse particles displayed no or fewer effect. Moreover, endotoxins were not involved in the ultrafine particle-induced GM-CSF secretion whereas they partially contributed to the fine particle ones as assessed by the use of endotoxin neutralizing recombinant protein. Considering PAH bioavailability, PM1-0.1 from winter samples induced the higher CYP1A1 activity whereas the CYP 1A1 activity increases as the size decreases with summer samples.

Chemical analyses enlightened the major presence of carbonaceous species in Paris aerosols especially in the ultra-fine and fine fractions where PAH are also predominant (90% in these fractions).

To conclude, we observed that the proinflammatory response of bronchial epithelial cells *in vitro* was closely related to particle size with ultrafine particles exhibiting the highest effect.

This work was supported by ADEME, the French environmental agency, under the PRIMEQUAL grant n° 0462C0056.

PM and NO_2 at urban sites with different traffic exposure: curb site measurements in Flemish cities

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Road transport is known as one of the main sources of urban air pollution, especially PM and NOx. Recently, studies have reported associations between residential proximity to busy roads and a variety of adverse respiratory health outcomes in children. Moreover, it was shown that traffic related pollution (PM, NOx and black carbon) is associated with respiratory symptoms in children.

The knowledge that PM may induce adverse health effects is an incentive for progressive cities to evaluate local air quality and to look for actions to be taken. Before cost effective measures can be taken, the actual air quality of the city has to be assessed in order to identify hot spot locations.

Existing air quality measurement networks measure air pollution at different sites and give an 'average value' for the surrounding area. However, most of these measurement stations are not located at hot spot locations e.g. close to busy roads. In Flanders, the daily average limit value for PM_{10} was exceeded more than 35 times in 17 of 31 monitoring sites in 2005.

Some of the larger Flemish cities have implemented innovative transport and mobility policies in the past decade. Before supplemental cost effective measures can be taken, the actual air quality of the city has to be assessed in order to identify hot spot locations. The aim of this study is to assess the air quality at urban (curb site) locations.

PM_{10} daily average values were measured during 3-4 weeks at 6 locations representing different 'typical' traffic locations: e.g. ring road, access road, parking route, local traffic. NO_2 was measured at all locations.

At the background location lowest concentrations were measured for all parameters. Differences in PM_{10} and NO_2 were observed between the different locations. It seems that NO_2 is more sensitive to traffic exposure than PM_{10}. This is due to the higher background and background variation of PM_{10}. At the bus location, highest NO and NO_2 values were measured. Highest concentrations of PM_{10} and black carbon are measured at the ring location. However some trends could not be explained.

Formation of sulphate in concentrated solutions of salts

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Chemical reactions in concentrated solutions of salts and electrolytes in general contribute to the transformation of atmospheric species. Laboratory experiments demonstrate that SO_2 is oxidised in solutions of salts (e.g. NaCl, $NaNO_3$), at relative humidity of 75% to 90% in air, in the absence of light. (This formation of SO_2 oxidation is enhanced by transition metals (e.g. Mn) and by NH_3). Under similar conditions formation of SO_2 is also observed on size segregated samples of atmospheric aerosols.

For SO_2 the highest formation rates observed in the laboratory are to the order of 0.01 mol of newly formed sulphate per mol of salt and per hour. When these data hold for the atmospheric sulphate aerosol, the formation rate would become 1% sulphate per hour. Consequently the excess of sulphate formed on a sample leads to a 4.6% increase of the aerosol sulphate concentration for an 8h sampling period, and to a 13.5% increase for a 24h sampling period, at constant sampling conditions including the aerosol.

Conclusions and suggestions:

- Chemical reactions in concentrated electrolytic solutions contribute to the transformation of atmospheric aerosol material and precursors, inorganic and organic. Long term sampling can therefore lead to considerable sampling artefacts due to reactions on or in the aerosol material. (Artefacts during sampling.)
- The transformations so far observed are slow. It is the question whether there are also fast reactions that change the composition of the aerosol, regarding the reactive species, upon humidification in the lung. If so, water is probably among the reactants. (Artefacts on humidification.)

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Translocation of particles, effects, and cellular interplay after exposure to fine particles and nanoparticles in an epithelial airway model

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So far, little is known about the interaction of nanoparticles with lung cells. Using a triple cell co-culture model of the human airway wall composed of epithelial cells (EC), macrophages (MP) and dendritic cells (DC) we studied the interaction of these cells with polystyrene particles (PSP) of different sizes (1 μm, 0.2 μm, and 0.078 μm) as well as with different nanoparticle (NP) types, i.e. gold (AuNP; 0.025 μm) and titanium dioxide (TiO_2NP; 0.02-0.03 μm) particles using laser scanning microscopy (LSM) and energy filtering transmission electron microscopy (EFTEM). The cellular pro-inflammatory response was determined by measurements of the tumor necrosis factor-α (TNF-α) in the supernatants.

By quantification of fine PSP and nano PSP inside the different cell types we found 6-9 times more 1μm and 0.078 μm particles within the cells than 0.2 μm particles. Furthermore the amount of particles which translocated into the cells was dependent on the cell type. The distribution of the different particles among the different cell types was compared using a contingency table analysis, and we could show that NP had different translocation characteristics than larger particles. TiO_2NP were detected as single particles without membranes as well as in membrane bound agglomerations. AuNP were found inside the cells as free particles only. We measured a 2-3 fold increase of TNF-α in the supernatants after applying 1μm PSP and AuNP, but not with nano PSP and TiO_2NP.

We found that the translocation of NP into cells was different from that of fine particles. We postulate that the size and material of the NP did not influence penetration into the cells but their localisation inside, i.e. free in the cytoplasm or membrane-bound, as well as their potential to induce cellular responses was different. Single NP which were not membrane-bound may have penetrated the cells by a mechanism which is different from endocytosis. This mechanism which is still unknown is likely to lead to a toxic effect because free NP may enter mitochondria or the nucleus.

Using LSM and digital image restoration MP and DC were found to interact with each other upon exposure to fine particles (1 μm). The two cell types may form a fine transepithelial network of interacting cell processes with which particles deposited on the epithelial layer can be transported to the base of the epithelial layer. This is postulated to be a mechanism by which particulate antigen can be translocated through the epithelial layer.

Particles and Health in Europe

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When unspecified ambient air fine particulate matter (PM2.5) turned out to be arguably the biggest environmental pollution risk to human life, it first (1993) raised surprise, was then deemed scientifically unexplainable until the accumulating evidence before and after 2000's established this as a broadly accepted fact.

Time series studies in the US, Europe (APHEA) and elsewhere have provided most of the current evidence. Yet, American cohort studies, the Harvard six cities study and the ACS study, have provided the most used PM mortality estimates. Interventions such as the Utah Valley Steel Mill strike and the Dublin coal ban of 1990, have added compelling evidence about the causal relationship between ambient PM and mortality.

Combining epidemiological, experimental and clinical findings from around the world has created a model of the complex pathways from PM exposure to CV mortality. ROS formation is a key mechanism. Probably primary combustion and transient metals particles are the most harmful, secondary particles and primary soil mineral particles less harmful, and sea-salt particles harmless.

PM2.5 mass and secondary particles are smoothly distributed over large areas, and ambient air monitors reflect exposures well. Exposure to traffic particles is elevated for those living close to busy traffic, and for all while in transit. Most of the exposure to particles of outdoor origin takes place indoors, because this is where ca. 90 % of the time is spent. Relative to outdoor concentrations, indoor exposure levels are 10 … 75 % lower due to filtration of the building envelopes and ventilation. Consequently ambient air monitoring overestimates population exposure to and underestimates the dose/response of PM2.5 of outdoor origin, and (ii) may both over- and underestimate individual exposures to traffic particles.

Searching for the mechanisms of interaction between nanoparticles and lung-cells

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Up to about 50% of atmospheric nanoparticles are composed of organic material but this highly complex organic mixtures are chemically only poorly characterized. The chemical composition, the surface chemistry and number of inhaled particles are likely important factors involved in adverse health effects associated with exposure to these particles. Therefore, potentially harmful aerosol components should be carefully monitored when studying the interaction of particles with the lung. Additionally, laboratory experiments investigating particle-lung interactions need to accurately reproduce the complex interaction between nanoparticles and the lung surface in order to identify the health relevant processes.

We developed an aerosol deposition chamber to expose lung-cell cultures to particles ≤ 1 μm in diameter using a conditioned airflow and mimicking closely the particle deposition conditions in the lung. In this new deposition chamber particles of different chemical composition are deposited highly efficient, reproducible and very uniformly onto the entire cell culture, a key aspect if cell responses are quantified in respect of the deposited particle dose for low-concentration atmospheric particles.
Online analyses of the lung cells, e.g. ciliary beat frequency, indicative of the defense capability of the cells, are complemented by off-line biochemical, physiological and morphological cell analyses. The suitability of the chamber for cells was successfully tested on lung epithelial cells and macrophages using (inert) particles of different sizes.

On-going research will investigate the cell responses to oxidized and atmospherically aged particles with organic and inorganic components.

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Relationship between ambient air pollution and daily mortality in the Urban Area of Katowice – comparison on two periods 1994-1995 and 2001-2002.

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Urban Area of Katowice is a heavily industrialized area of Poland with population about 2 millions inhabitants and total number of deaths about 20 000 per year. Air pollution levels in this region remain high, especially during the heating season, because of a dominant method of energy production and heating of houses, based on coal combustion.

The aim of the study was to analyze the current relationship between daily total and specific mortality and daily PM_{10}, SO_2 average area concentrations in the ambient air and to compare the estimated relative risk associated with the levels of pollution, obtained seven years apart. Both time-series analyses (1994/5 and 2001/2) were performed by the same method (Poisson regression model) in the same area. The effect of air pollution (either SO_2 or PM_{10} in a model) on daily count of mortality (total and cardiorespiratory deaths) was controlled for meteorological variables and season effect.

The comparison of current estimates with the findings obtained in the past suggests that the magnitude of the risk is similar for both periods. The range of the relative risk ratio for total mortality end-points related to a 10 $\mu g/m^3$ increase of PM_{10} concentration in total population of Katowice amounts: 1.007 in 1994/95 and 1.003 in 2001/02. The range is close to the value published by WHO in 2004. Sulphur dioxide is the predominant air pollutant associated with day-to-day variation in mortality, in the Urban Area of Katowice.

This project was supported by the State Committee for Scientific Research, Poland (Grant: COS/87/2006)

Assessing long-term exposure to traffic-related air pollution in a large Swiss Cohort (SAPALDIA)

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While evidence on acute health effects related to traffic exhaust is accumulating, little is known about long-term effects of traffic-related air pollution in the general population. This study, as part of the Swiss cohort study of air pollution and lung function in adults (SAPALDIA), investigated spatial variation of traffic-related NO_2 within and between 8 areas in Switzerland in 1993 and 2002. A dispersion model of 200x200 m resolution was used to predict NO_2 concentrations at residences of 9651 subjects in 1990 and 2000, respectively. In 1993 and 2003, weekly passive NO_2 measurements were collected outside 60 homes per area. This paper compared the dispersion model results for NO_2 with home outdoor measurements. Predictions for home outdoor NO_2 were refined by incorporating the dispersion model predictions in a land-use regression model that included local parameters from the geographic information system (GIS), meteorological variables, and interaction terms between the GIS and meteorological parameters. Our results indicate that the dispersion model alone does not predict NO_2 well within cities, with an R^2 ranging between 0 and 0.75 depending on area. Our hybrid models incorporating the dispersion predictions as the background layer, GIS parameters to enhance the local characteristics, and meteorological variables to add temporal dynamics, perform very well with an R^2 ranging between 0.77 and 0.96 for all areas. These individual exposure estimates provide powerful tools in health effect assessment for traffic-related exposure.

Health effects of air pollution in a large Swiss Cohort (SAPALDIA)

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The SAPALDIA cohort (Swiss Air Pollution And Lung Diseases in Adults) consists of 9'651 randomly selected subjects from 8 different sites representative of various conditions of urbanization and climate of Switzerland. The participants (age 18 – 60 at baseline) underwent detailed health questionnaire and spirometry in 1991 and were re-examined in 2002. In addition a sample of 1837 participants ≥ 50 years of age had 24h ECG recording in 2002.

First results indicated significant association of spirometry results and respiratory symptoms with local, annual mean concentration of PM10 and NO2 obtained at local monitoring stations of the eight regions. Assessment of exposure to traffic exhaust by distance from home to the next main road also showed significant association with respiratory symptoms. Finally, modellization of individual exposure will allow to estimate the change of PM10/NO2 concentration experienced by each participants from 1991 to 2002 as well as individual cumulative exposure over the same period of time. These data will make it possible to look for association with cardio-respiratory parameters such as pulmonary function tests, respiratory symptoms, and heart rate variability.

Assessment of Diesel exhaust particulate exposure and surface characteristics in association with levels of oxidative stress biomarkers

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Keywords: Diesel exhaust, Aerosol sampling, Aerosol size distribution, Aerosol-surface reactions, Health effects of aerosols.

Exposure to PM_{10} and $PM_{2.5}$ (particulate matter with aerodynamic diameter smaller than 10 □m and 2.5 □m, respectively) is associated with a range of adverse health effects, including cancer, pulmonary and cardiovascular diseases. Surface characteristics (chemical reactivity, surface area) are considered of prime importance to understand the mechanisms which lead to harmful effects. A hypothetical mechanism to explain these adverse effects is the ability of components (organics, metal ions) adsorbed on these particles to generate Reactive Oxygen Species (ROS), and thereby to cause oxidative stress in biological systems (Donaldson *et al.*, 2003). ROS can attack almost any cellular structure, like DNA or cellular membrane, leading to the formation of a wide variety of degradation products which can be used as a biomarker of oxidative stress.

The aim of the present research project is to test whether there is a correlation between the exposure to Diesel Exhaust Particulate (DEP) and the oxidative stress status. For that purpose, a survey is conducted in real occupational situations where workers are exposed to DEP (bus maintenance yard).

Different exposure parameters have been considered:
- particulate number, size distribution and surface area (SMPS);
- particulate mass - $PM_{2.5}$ and PM_4 (gravimetry);
- elemental and organic carbon (coulometry);
- total adsorbed heavy metals - iron, copper, manganese (atomic adsorption);
- surface functional groups present on aerosols (Knudsen flow reactor). (Demirdjian *et al.*, 2005)

Several potential biomarkers of oxidative stress (8-hydroxy-2'-deoxyguanosine and some aldehydes) have been determined either in urine or serum of volunteers.

Results obtained during the sampling campaign in several bus depots indicated that the occupational exposure to particulates in these places was rather low (40-50 □g/m^3 for PM_4). Size distributions indicated that particles are within the nanometric range. Surface characteristics of sampled particles varied strongly, depending on the bus depot. They are usually characterized by high carbonyl and low acidic sites content.

Among the different biomarkers which have been analyzed within the framework of this study, 8-hydroxy-2'-deoxyguanosine mean levels in urine have been observed to increase significantly ($p<0.05$) during two consecutive days of exposure for non/old-smokers (n=15).

Correlations between the exposure parameters and the formation of ROS by-products have to be done in order to know if the observed biological effect can be related to particulate exposure.

This project is financed by the Swiss State Secretariat for Education and Research. It is conducted within the framework of the COST Action 633 "Particulate Matter – Properties Related to Health Effects".

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Research needs for Health Effects of Air Pollution – CONCAWE recommendations for FP7

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(the oil companies' European organisation for environment, health and safety)

An open international workshop was convened in January 2007 to debate research needs for the EU in the field of health effects of ambient air pollution in the wider context of environment and health. Following a series of scientific updates workshop participants produced in facilitated discussion sessions a set of recommendations as follows:

Strategic research direction:
- improved coordination of research in this area
- better and more frequent synthesis and interpretation of research findings, using methodologically more rigorous approaches to evaluate the weight of scientific evidence
- for large, long-term projects available funding from different sources (EU, national, institutional) needs to be linked

Identified priorities for specific studies included:
- European prospective cohort analysis, with exposure assessment on the individual level including such features as biomarkers
- assessment of public health impacts of traffic emissions
- refinement of particulate matter metric(s) to measure health impacts
- elucidation of mechanisms of toxic action
- development of toxicity screening approaches for emissions to air
- improvements in cost-benefit analytical tools

Improvements to the science-policy interface:
- research to track impacts of implemented policy measures ('accountability research')
- improvements in interdisciplinary exchanges
- linkage of research project to time windows of expected policy needs

Workshop proceedings will be published and will form the basis for further work programmes.

Overview on the activities of COST633 Working Group 3: source apportionment methods EU

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The focus of COST Action 633 Working Group 3 (WG3) is directed towards the evaluation of the availability and application in COST633 member countries of emission inventories, dispersion models, source apportionment methods and integrated assessment models. To this end, a compilation of meta-data among the COST633 member countries was carried out by means of questionnaires. The results from the questionnaires may be seen as an overview on the dispersion modelling and source apportionment activities in Europe before the year 2006. In the case of source apportionment methods, a total of 47 publications were reported from 7 countries based on 10 different methodologies. The evaluation of the resulting data showed a broad range of PM10 and PM2.5 sources across Europe, as well as the different criteria adopted to interpret the nature of such sources. Achieving comparable results was identified as one of the major challenges in Europe. The relevance of sources such as regional background contributions road dust or shipping emissions, some of them unobserved in the reported studies, was evidenced.

Release of particulate material into the atmosphere: quality considerations of PM emission inventories

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Transfer of material into the atmosphere is a key factor influencing atmospheric concentrations of trace constituents. Emission inventories provide the information needed to understand and quantify this process. In contrast to inventories of gaseous pollutants, which are well-established, inventories of particulate matter (PM) suffer from a low level of reliability. While considerable efforts for improvements are underway, the major obstacles are specific properties of PM. PM is not a unique substance, but an internal and/or external mixture of a multitude of compounds from very different origin, different effects on substrates, and different size. Quantification of emission rates is hampered by their strong dependencies on measuring conditions (temperature, lapse time) and process state (start-up vs. equilibrium). Successful efforts to abate emissions have lead to a situation where emissions very strongly depend on the technology of PM abating equipment used – for which information often is not available on an aggregate level. Furthermore, abatement measures have very different effects on different particle size classes, and typically rather influence larger size fractions. Emission rates, e.g. in domestic heating from small installations, are strongly determined by national and regional habits, making it difficult to identify appropriate emission factors and use them for a larger domain. Information on fugitive emissions is sparse, i.e. suspension of particles due to wind shear, loading processes or other mechanical forces which are not contained in an exhaust air duct. This concerns activities in industry and agriculture, but also motorized vehicle traffic in addition to exhaust (Diesel) particles. Comparing independent efforts in assessing emissions, here national data (from Austria) to the trans-national estimates of IIASA's GAINS model, allows to better understand and quantify an inventory's significance. Methodological improvements and harmonization efforts currently under way in Europe will focus activities and allow for more reliable PM inventories in the near future.

Part B) Abstracts of COST 633 Special Session at the European Aerosol Conference, Salzburg, Austria, September 2008

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Cross-disciplinary approaches for critical issues in particulate air pollution

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Keywords: Particulate Matter, Measurements, Health aspects of Aerosols, Source apportionment, Modelling

The field of the COST Action 633 "Particulate matter (PM) – properties related to health effects", is very broad and covers several disciplines. It includes, e.g. measurement techniques of PM, measurement artifacts, consideration of parameters to be measured, epidemiology, toxicology, modelling of exposure, emission inventories, source apportionment and dispersion modelling, and integrated assessment modelling.

All the various disciplines had and have accumulated a vast amount of knowledge was, and partially still is, hard to communicate to the public and decision-makers, and even between the researchers. The Action was especially initiated to enable communication and enhance the interactions between the various disciplines, since the progress needed for the improvement of air quality and quality of life can only be achieved by coordinated efforts. This was accomplished by the COST 633 Action bringing together a multidisciplinary team of scientists to tackle are faced with the complex problems posed by PM to society.

There are three working groups in the Action: WG1 - air quality and instrumentation, WG2 - Health related issues of particles, and WG3 - Sources, emission, modelling, economic aspects. In the Action, however, we a cross-disciplinary approach involving all the experts was taken.

The Action has already given some major recommendations:

- Extension of the current air quality monitoring network is needed in Europe. Additional particle parameters should be measured preferably in urbanized areas.
- A possible new focus could be the combination of emission inventories, chemical transport models and source apportionment methods into an integrated approach. While each tool separately is not capable of answering all questions, in combination they could provide a more detailed insight to issues such as regional variability of contributions by traffic, wood burning, etc.
- There is a need to assess the uncertainty of existing models rather than to develop new models.
- Long-term exposure estimates need to be improved and developed, especially taking the indoor situation into account.
- Development of high resolution spatial exposure models for the estimation of chronic, long-term particle exposure and studies in selected regions in Europe on long-term effects of air pollution with standardized procedures in both health and exposure assessment are needed. To appropriately investigate chronic effects, such studies must focus on early pathophysiological or functional markers of chronic diseases rather than on terminal outcomes.
- Better integration of epidemiology and toxicology is needed, using for instance same health indicators (biomarkers of effect).
- Source-related toxicological studies should be conducted, preferably using real world mixed samples from different regions of Europe.
- There is an obvious need for collaboration and interdisciplinary approaches, and a call to conduct well organized concerted research studies in several regions in Europe comprising monitoring and research on air pollution, exposure, epidemiology with appropriate exposure-response functions, source-orientated toxicological studies as well as evaluation of the effectiveness of various abatement measures.

This work was supported by COST Action 633. Comprehensive information on the COST Action, including recent Conference Proceedings, can be downloaded from http://cost633.dmu.dk

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Differences and Similarities in PM Characteristics across Europe: Results of the COST633 Data Compilation Activity

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Keywords: Particulate Matter, Measurements.

Epidemiologic studies have shown a close relationship between particulate matter (PM) mass concentrations and mortality and / or morbidity (e.g. Dockery et al., 1993). However, they have also pointed out spatial differences in the heath impact of PM mass concentrations or mass concentration increments (e.g. Le Tertre et al., 2005). One of the reasons for this might be that PM characteristics (chemical composition, size distribution) do vary from place to place, both at a large scale (across a continent) and at a more regional / local scale (from rural background to kerbside sites). To test this hypothesis, the results of the epidemiological studies should be confronted to PM characterisation data, beyond the only PM mass concentrations reported by the air quality monitoring networks.

Such parameters (PM mass concentration, chemical composition and particle number concentration and / or size distribution) have been measured at various locations in Europe for many years. However, most of them rarely reach possible users such as epidemiologists, modellers, and policy makers.

We aimed at closing this gap by complementing the data compilations by Van Dingenen et al. (2004), and Putaud et al. (2004), based on a more systematic survey of the available aerosol data across Europe, made possible by the official collaboration of the 20 signatories of the COST633 Action. We identified 94 (+24) new data sets containing PM mass and chemistry for at least 1 year (or several weeks), and 21 (+7) data sets including PM mass and particle number data, which cover 13 countries. Up to now, 34 datasets from 8 countries have been delivered to the COST633 data bank (Fig. 1).

These data have been aggregated to the ones already available to highlight differences and similarities in PM characteristics across various scales in Europe.

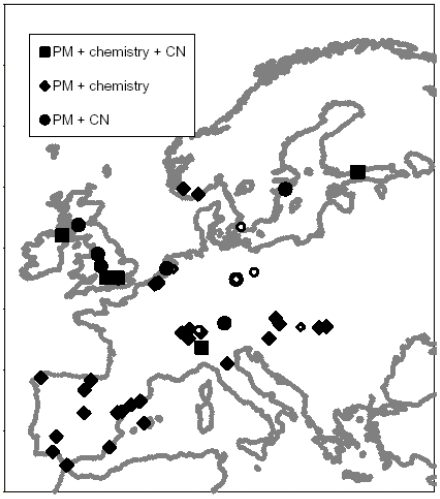

Figure 1. Location of the sites where PM mass and characterisation data were collected from.

This work was supported by COST Action 633 "Particulate matter (PM) – properties related to health effects"

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Overview of source apportionment methods in selected European COST633 Action member countries

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Keywords: ambient PM, source contribution, receptor models, road dust, shipping emissions.

During the progress of COST Action 633 and within its Working Group 3 (Sources, Emissions, Modelling, Economic Aspects), a questionnaire was distributed amongst the Action's participant countries with the aim to compile data on the source apportionment methodologies used in the different countries. This questionnaire included data on the PM fraction targeted, sampling methodology and study area. Despite the fact that replies to the questionnaires were not obtained from all the member countries, the return may be seen as an overview on source apportionment activities in Europe before the year 2006. It should be noted, however, that this overview does not intend to provide the full set of all source apportionment studies performed in the European COST633 Action member countries.

The different member countries reported a total of 47 publications on source apportionment in 7 countries (Austria, Belgium, Finland, Germany, Portugal, Spain, Switzerland, UK), based on 10 different methodologies: Principal Component Analysis (PCA, Thurston & Spengler, 1985), CMB (Chemical Mass Balance, US-EPA, 1987), Positive Matrix Factorisation (PMF, Paatero & Tapper, 1994), UNMIX, ME (Multi-Linear Engine, Paatero, 1999), Lenschow approach (Lenschow et al., 2001), back-trajectory analysis, cluster analysis, COPREM (Constrained Physical Receptor Model, Wåhlin, 2003) and isotopic mass balance using C-14 (Szidat et al., 2004). The most frequently used method was PCA (30% of the studies), followed by back-trajectory analysis and the Lenschow approach (15%), and PMF (10%). The remaining methods were used in at most 2 studies each. Regarding the number of research groups applying the different techniques, PCA appeared to be most widely used (5 different countries), whereas PMF and the Lenschow approach were applied in 4 and 3 countries, respectively.

Aside from the techniques reported by COST633 member countries, it is also important to acknowledge the use of CMF (Constrained Matrix Factorisation) and SOMs (Self-Organising Maps), as well as the relative increase in the use of PMF and CMB in Europe in the last year.

The evaluation of the data provided by the member countries showed a large number of PM10 and PM2.5 sources identified across Europe, as well as the different criteria adopted by researchers in order to interpret the nature of such sources. For example, some sources were interpreted as specific industrial processes such as "Metallurgy", whereas in other regions more general sources such as "Trans-boundary pollution" were reported. Consequently, the inter-comparison of results is in such cases complicated. Achieving comparable results over Europe is certainly one major task to tackle. Another issue evidenced by this analysis is the relevance of regional background contributions to PM levels, which were identified at most of the monitoring sites although with different tracer elements. Traffic contributions, e.g. exhaust and road dust, were identified in urban areas only by certain models, evidencing a clear research need. This also applies to other combustion sources such as shipping emissions, unobserved in the reported source apportionment studies.

The authors would like to thank all the researchers who provided data for the questionnaires. This work was carried out under COST Action 633.

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Modelling exposure to atmospheric particulate matter– an overview

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Keywords: modelling, air quality, exposure.

Exposure is one of the main factors determining risk assessment and risk management. According to the IPCS (2004) an exposure model is a conceptual or mathematical representation of the exposure process, designed to reflect real-world human exposure scenarios and processes, and thus, it combines information on personal activity patterns and media (indoor and outdoor) air concentrations. Ambient air concentration of particulate matter (PM) is then a key input variable for exposure models, and are generally obtained by direct measurements in air quality monitoring stations. However, depending on the location and dimension of the region to be studied, monitoring data could not be sufficient to characterize PM levels or to perform population exposure estimations. Numerical models are alternatives to measured concentration data. They simulate the changes of pollutant concentrations in the atmosphere using a set of mathematical equations characterizing the chemical and physical processes in the atmosphere.

Aiming to provide an overview of the application of PM models in European COST633 Action member states in a common usable framework, modellers were asked to answer to a questionnaire (Miranda *et al.*, 2006). A total of 30 case studies applications and 20 models were reported, covering different scopes and different modelling scales, from the local to the regional scale. Primary aerosols were simulated in all the case studies, whereas secondary aerosols were included in 50% of the cases, estimating not only PM_{10}, but also $PM_{2.5}$ and SOA.

A number of exposure modelling studies based on air quality modelling results combined with population activity patterns have already been performed, namely in the scope of the European Project FUMAPEX. Fig 1 presents the results of the estimation of children exposure in Turin city area. A mesoscale model was used to obtain PM_{10} ambient concentrations.

A methodology to estimate the population exposure to PM_{10} in urban areas was developed and applied to a hot spot in Lisbon city centre. Results of PM_{10} air concentration field predicted by VADIS local dispersion model and the population exposure expressed in terms of an accumulated index (APEI50) are presented in Fig 2.

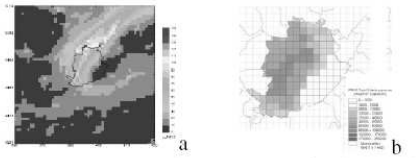

Figure 1. PM_{10} simulated concentration field (a), and spatial distribution of 24-hours total PM_{10} exposure (b) (Hänninen *et al.*, 2005).

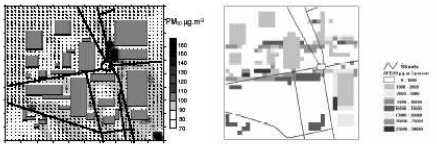

Figure 2. PM_{10} simulated field and exposure results for an urban area in Lisbon (Borrego *et al.*, 2006).

From this overview we can conclude that air quality models are already used as input for exposure modelling and health related issues, but a wider effort is still needed to combine these PM air concentration models with personal activity patterns and indoor concentration values.

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Heterogeneity in toxicity of particulate matter collected across Europe

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Keywords: Heterogeneity, Toxicity, Particulate Matter, Health, Air pollution.

The adverse health effects associated with ambient air pollution has triggered epidemiologists, toxicologists and aerosol scientists to combine their experience in investigation of the toxicity of ambient air particulate matter (PM) from European sites with differing traffic intensity and source mixture. The aim has been to increase the understanding of the role of fine and coarse PM, and their chemical characteristics, in relation to health effects. Under the European Union 5th Framework Programme (FP5), the HEPMEAP, RAIAP and PAMCHAR projects have utilised high volume cascade impactors to collect size-segregated PM in a variety of European locations during different seasons and performed a whole range of laboratory investigations. In general, the samples of both the coarse (2.5 - 10 µm) and fine (0.1 / 0.2 – 2.5 µm) thoracic PM were able to induce significant toxic effects. The sources and chemical composition of the PM samples have been suggested to play an important role in these responses.

Respiratory Allergy and Inflammation Due to Ambient Particles (RAIAP)[a)]

The overall objective of the RAIAP research project (QLRT-2000-00792) has been to assess the role of ambient suspended particles in causing local inflammation in the respiratory tract and induction and elicitation of respiratory allergies, in order to understand the underlying mechanisms for involvement of particles in the development of these diseases. Coarse and fine PM were collected in four European cities during three seasons.

Health effects of particles from motor engine exhaust and ambient air pollution (HEPMEAP)[b)]

The project (QLK-CT-1999-01582) focuses on the assessment of the inflammatory and toxic potential of ambient air suspended particles (collected at locations across Europe with contrasts in traffic intensity) in comparison with diesel engine exhaust PM. The investigators have assessed and compared the overall toxicity in vitro and in vivo in animals and humans. Moreover, these data and the physico-chemical characteristics of ambient air PM have been related to health effects noted in epidemiological studies.

Chemical and biological characterisation of ambient air coarse, fine, and ultrafine particles for human health risk assessment in Europe (PAMCHAR)[c)]

The PAMCHAR project (QLK4-CT-2001-00423 investigates the physico-chemical and toxicological characteristics of ambient air coarse ($PM_{10-2.5}$), fine ($PM_{2.5-0.2}$) and ultrafine ($PM_{0.2}$) particles in geographically and climatologically contrasting PM pollution situations in Europe. It focuses on comparison of the inflammatory, cytotoxic and genotoxic activities of PM samples in relation to their greatly varying chemical composition and sources.

Results and conclusions

Oxidative and immunotoxic effects have been demonstrated in several in vitro and animal models. PM from traffic, and other local sources of incomplete combustion such as small-scale biomass and coal heating, have a high toxic potential. Coarse and fine PM have both been capable of inducing toxicity but via different modes of action. The chemical composition of PM seems to play an important role and although the view on causative components is not definite, metals and hydrocarbons appear to be consistently associated with toxic responses. Ambient PM has been shown to increase allergic responses in experimental animals. Asthmatics have been demonstrated to be particularly sensitive to diesel exhaust by showing clearly increased bronchial hyperresponsiveness. The acute inflammatory response in the airways of asthmatic subjects differed between the fine and coarse PM. This may indicate that the pre-existing asthmatic airway inflammation plays a role in the sensitivity of these subjects to air pollution, as suggested by epidemiological studies. The studies in cell lines and in animals have shown that the physico-chemical characteristics are generally more predictive for health effects than the PM mass. Decision-makers should integrate the PM composition and toxicity research findings into further refinement of the PM exposure and health risk assessment as well as into continuous improvement of management strategies for emission sources and urban air quality.

a) www.raiap.org; b) www.hepmeap.org; c) www.pamchar.org

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Similarities and heterogeneities in exposure and health effects over Europe – Epidemiological results and research needs identified in COST Action 633

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Keywords: airborne particles, aerosol characterization, epidemiology, health effects of aerosols, modelling.

Short-term and long-term exposure to ambient airborne particulate matter (PM) is associated with increased prevalence of respiratory and cardiovascular diseases and mortality.

Many acute health effect studies observed regional heterogeneities in the association of daily variations in mass concentrations of ambient airborne particulate matter (PM) such as black smoke, thoracic, or fine particles with cardiovascular or respiratory mortality and morbidity.

Heterogeneities can also be observed related to PM-sources. Particles from local combustion sources have more consistent and stronger relationships with both respiratory and cardiovascular outcomes than PM from other sources. However, there is currently not enough scientific evidence to declare any source or chemical composition as "non-toxic", because even sea salt and soil-derived particles may interact in urban areas with local anthropogenic particles.

It is possible that physicochemical differences in PM mixtures contribute to these observed heterogeneities, but there may well be other reasons such as ambient temperature, differences in exposure patterns of the populations, and differences between the sites of monitoring stations in different countries. The role of population characteristics such as genetic and socio-economic differences is not known, while factors like dietary intake of antioxidants or use of such supplements could well have an impact.

Only few European studies investigated so far long-term health effects of exposure to ambient particles. The existing data allows the conclusion that chronic, long-term PM-exposure causes health effects that go beyond those expected for repeated short-term exposures. However, too few studies and data exist to draw conclusions about heterogeneities of long-term health effects in European populations and the relation of such heterogeneities to sources or particle characteristics. This gap of knowledge exists on a European as well as on a worldwide scale.

Understanding the heterogeneities over Europe will require a better spatial and physicochemical characterisation of particle exposure, a better description of the activity patterns, genetics and socioeconomics of exposed populations and the inclusion of markers of diseases.

Studies require sufficient exposure gradients to detect effects. Central monitoring sites were useful to examine acute health effects of PM in time-series studies because the temporal sequences of PM at different sites in a given region are usually well correlated. However, the understanding of source- and physicochemical- specific PM effects requires methods that capture contrasts in exposure to pollutants that are heterogeneously distributed. This is especially important for chronic effect studies. Given the inability to measure the personal exposure over long periods of time, combinations of measurements and modelling will play an important role in future research.

Genetic polymorphisms can modify the response to oxidative stress and/or systemic inflammation. However, we do not sufficiently understand how this translates into the risks, and other genes and pathways are expected to play a complementary role in the development of diseases.

Socioeconomic factors are proposed to affect the dose-response relationship between air pollutants and health in two ways: They can affect the exposure (e.g. low income housings near busy streets), and they can affect the susceptibility of the individuals to the pollutants (e.g. lifestyle factors such as smoking or dieting, and co-morbidities such as diabetes)

Finally, including preclinical markers of diseases and disease development will be important to distinguish between pathophysiological changes that contribute to chronic diseases and reversible changes that trigger acute events.

This work summarizes the findings of the epidemiology sessions of the COST633 Workshop in Vienna, 3 - 5 April 2006.

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Generation and Quantification of Organic Peroxides in Aerosols to Study Cellular Responses on Oxidative Stress

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Keywords: Aerosol instrumentation, Deposition, Generation of aerosols, Lung/particle interaction, SOA

Ambient fine and ultrafine particles have, besides of impacts on atmospheric processes, a variety of adverse health effects, from which respiratory diseases have attracted a lot of attention in media. Up to about 50% of the ambient aerosol is composed of organic material. However, the highly complex organic mixture is chemically poorly characterized (Baltensperger *et al.* 2005; Kalberer 2006). The reaction of terpenes with ozone in the polluted troposphere mainly generates aldehydes, carboxylic acids and organic peroxides. The contribution of these peroxides to health risk is assumed to be especially important because of their high reactivity and oxidation potential.

The aim of this work is to characterize and quantify oxidizing agents in aerosols generated under controlled conditions in a flow tube setup (figure 1). In an accompanying project, lung cells are then examined for morphologic, biochemical and physiological changes after exposure to these aerosol particles.

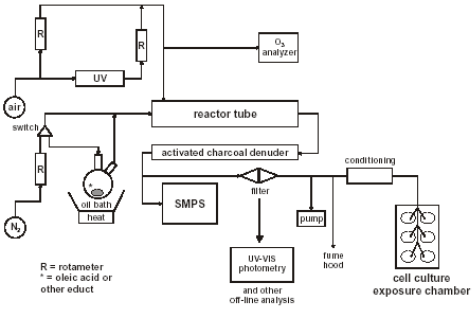

Figure 1. Scheme of the experimental setup.

First experiments were performed by reaction of ozone with oleic acid aerosol particles, which are often used as a model substance for terpenes due to its reactive double bound. Ozone was obtained by photolysis and radical reaction of oxygen from compressed air. Both components were led to the reaction chamber, a glass tube of about 1.5 l in volume. Then, ozone and other volatile products were removed by an activated charcoal diffusion denuder. The peroxide particles were collected on a filter and their concentration was quantified off-line by UV-VIS spectrophotometry. The iodometric reaction used here allows to determine the total amount of -ROOR- groups in a sample (Docherty *et al.*, 2005). Oxidized oleic acid particles were produced with varying amounts of peroxides. Further analyses by chromatography and MS methods will elucidate the chemical composition of the generated aerosols. The particle size distribution was analysed by a scanning mobility particle sizer, SMPS.

Simultaneously to collecting the reaction products on a filter, the particles were also deposited directly onto the air-liquid interface of lung cell cultures. In this on-line particle deposition chamber, charged particles were deposited in an electrical field onto six parallel cell culture wells. The air flow was conditioned to a constant temperature, humidity and gas composition prior to contact with the cell cultures.

This setup can be easily adapted to study particle formation in various systems of organic aerosols. The functioning of the instrument has been tested thoroughly and first results indicate that test particles can be deposited evenly onto lung cell cultures. However, stable aerosol flow conditions are still difficult to achieve due to the sensitivity of the setup to temperature and pressure fluctuations. A comparison of the cellular responses to inert polystyrene test particles and to peroxide aerosol particles will be presented.

These analyses of oxidation properties of organic aerosols will greatly help to understand the cellular responses induced by fine and ultrafine particles. The main hypothesis of this project is, that the oxidation capacity of organic particles is mainly responsible for their biological effects.

This work was supported by SBF under grant Nr. C06.0075 as part of the COST Action 633.

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Analysis of contribution of different sources to PM10 concentration levels at three different locations in Slovenia

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Keywords: PM10, urban aerosols, chemical composition, source identification

Non-attainment of air quality standards regarding particulate matter is frequently observed in many cities in Europe. Urban areas contain a large concentration of people and also anthropogenic industrial and traffic activities. Several reports revealed elevated concentration levels of PM, its spatial and temporal distribution (Gomiščck *et al.*, 2004) as well as significant correlation between particulate matter levels and adverse effects on human health (Pope, 2000). Therefore, it is great importance to understand chemical composition and source apportionment in oreder control air pollution in these areas. For preparation of effective abatement strategies to reduce particulate matter levels, it is necessary to obtain contributions of different sources. Several techniques are available for this task. However, the most widely used are Principal Component Analysis, Chemical Mass Balance, Positive Matrix Factorisation, back-trajectory analysis, Lenschow approach (Lenshow *et al.*, 2001; Paatero and Trapper, 1994; Thurston and Spenger, 1985, US-EPA, 1987).

The present study is focused on detailed chemical characterization of PM10 sampled at three different locations in Slovenia followed by detailed interpretation of data using back trajectories and other relevant meteorological data. For source identification multivariate statistical technique will be applied.

Sampling of PM10 was performed at three different locations in the period between December 2006 and February 2007. The sampling site in Ljubljana, situated in a residential-commercial area, represents urban background location. The location in Maribor is a typical traffic location, while the location at Trbovlje is situated in rather closed valley and is predominantly influenced by traffic and a cement industry plant. Sampling was performed by low volume reference samplers (Leckel) on 24 hour basis. In addition continuous measurements of PM10 by TEOM and measurements of black carbon by Aehalometers were carried out. All measuring sides are equipped also with common meteorological sensors and monitors for SO_2, NO_x and O_3. 5-days back trajectories were calculated for each day of the measuring period.

After sampling, filters with were divided into three sub-samples. Following the extraction in Milli-Q water analysis of major ions was performed by ion chromatography with one part of the filters. The second part was digested by HNO_3 and H_2O_2 according to SIST EN 14902 in order to carry out the determination of selected trace elements by ICP-MS. The third part was used for the determination of total and elemental carbon.

In table 1 average yearly concentration of PM10 and number of days above the 24-hour limit value (50 $\mu g\ m^{-3}$) in 2006 are presented for all three locations. For comparison data for background EMP-GAW station Iskrba are shown.

Table 1: Average yearly concentration of PM10 and number of exceedances of limit value (50 $\mu g\ m^{-3}$) in 2006 for selected locations - Ljubljana, Maribor, Trbovlje and Iskrba.

	Average yearly concentration [$\mu g\ m^{-3}$]	Number of exceedances of limit value
Ljubljana	36	51
Maribor	45	117
Trbovlje	42	92
Iskrba	14	3

In this contribution the results of the intensive campaign regarding elevated PM10 concentration levels, chemical composition, principal contribution sources and paths as well as source apportionment will be presented and discussed.

This work was supported by the Ministry for Environment and Spatial Planning of the Republic of Slovenia and was done in the frame of COST-633 Action.

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Seasonal variability of air pollution and mortality in the Urban Area of Katowice, Poland

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Keywords: mortality, ambient air pollution, time-series study.

Epidemiological evidence has proven a significant association between ambient air pollution (gaseous and particulate) and daily total and specific mortality. A number of papers have also indicated a strong impact of the season on the overall magnitude of the risk of additional death [1, 2]. The latter effect could be modified by the sources of air pollution and meteorological conditions [3,4].

The aim of the study was to analyze the current relationship between seasonal variability of the daily total and specific mortality (cardiovascular and respiratory mortality) and daily PM_{10}, SO_2 and NO_x average area concentrations in the ambient air in the Urban Area of Katowice.

Daily counts of deaths in 2001-2002, in the study region, were obtained from the Central Statistical Office in Warsaw. The records included total number of deaths, the number of deaths due to cardiovascular and respiratory diseases, for the entire population and in two age categories: <65 years and 65+ years of age. The classification of causes of death was based on the International Classification of Diseases ICD-10. Data concerning ambient air pollution and meteorological conditions (temperature, atmospheric pressure and relative humidity) were calculated as 24-hour area averages. The data set included also a four-level variable describing a climatic season ('winter', 'spring', 'summer' and 'fall').

Relationship between the daily number of deaths and daily concentrations of pollutants, and metrological parameters in the defined seasons was estimated by means of Spearman correlation analysis. Analyses were performed with the use of procedures available in the Statistica 7.0 program.

Table 1 shows the average daily counts of deaths by season, in the Urban Area of Katowice in the period 2001-2002.

Figure 1 presents average daily concentrations of each other examined air pollution, by season, in the study area.

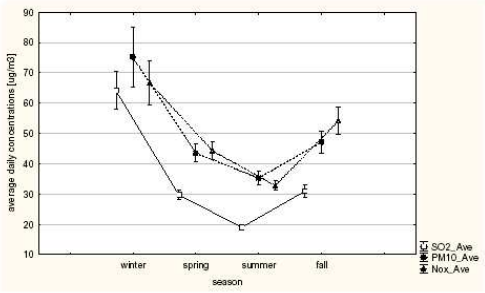
We noted statistically significant relationship between daily number of deaths due to cardiovascular/respiratory diseases and sulphur dioxide concentration in winter and in spring (Spearman correlation coefficient amounted: 0,24 and 0,21, respectively).

Similar effect was seen in the elderly (population aged 65+ years), but only in spring time. We observed also a high correlation between temperature and sulphur dioxide concentration in cold seasons (winter and fall).

Table 1. Average daily counts of deaths in the Urban Area of Katowice, by season (2001-02).

Season	Total number of deaths	Number of deaths from CVD and RD
Spring	53,8 ± 8,1	27,2 ± 5,7
Summer	50,5 ± 7,6	25,0 ± 5,3
Fall	52,7 ± 8,2	26,7 ± 5,5
Winter	57,8 ± 7,5	30,9 ± 6,1

Figure 1. Average daily concentration of air pollutants in Urban Area of Katowice , by season (2001-2)



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$PM_{2.5}$ site/seasonal variability in Ireland: toxicological effects

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Keywords: *$PM_{2.5}$, chemical composition, toxicity, health effects*

Whilst internationally collected data demonstrating that adverse health effects correlate with Particulate Matter (PM), major questions, concerning the mechanisms by which they act, remain.

Chemical analysis shows PM to comprise of many inorganic, organic, and elemental materials, several of which promote adverse toxicological responses. For example, transition metals have long been recognised as toxic components of particles found in occupational settings and there are a number of well-characterised pathological diseases caused by the inhalation of particles of specific metallic compounds. (Samet *et al*, 2007)

Therefore it is important to determine the contribution of metals and other chemical components, to the adverse health effects observed in PM epidemiology studies. Project ERITASK is the first of its kind in Ireland to encompass the four necessary stages to characterize ambient $PM_{2.5}$: 1.Sampling 2.Physico-chemical compositional analysis. 3. Toxicological studies, and 4.Chemometrics/statistical analysis. The ultimate aims are to determine both the hypothesised link that exists between $PM_{2.5}$ composition and its potential toxicity and also to investigate any geographical and seasonal differences for $PM_{2.5}$ sampled in the urban area of Cork City.

$PM_{2.5}$ has been collected at three sites located throughout Cork, Ireland (Urban/City centre, urban background and a rural site). The collections were made on Polyurethane foam (PUF) filter substrates using a high volume cascade impactor sampler ($900Lmin^{-1}$). Elemental concentrations of representative suites of 20 metals were determined using microwave extraction and ICP-OES spectrometry. In addition, aqueous extracts were analysed, after sequential agitation/sonication to quantify the solubility (bioavailability) of the different metal components (ICP-OES). This procedure was also utilised in the determination of the inorganic ion content of the $PM_{2.5}$ by ion chromatography. Both the % total carbon was determined (CE440 Elemental Analyser) and the endotoxin content determined for the $PM_{2.5}$ sampled.

To investigate the biological effects of $PM_{2.5}$ at a sub-cellular level, the human epithelial pulmonary A549 cell line was exposed for 72hrs to different concentrations of $PM_{2.5}$ (0, 5.5, 11.0, 22.0 $\mu g/cm^2$). As an index of cytotoxicity after $PM_{2.5}$ exposure the activity of LDH released from the cytosol of damaged cells into the supernatant was determined. *In vitro* cell proliferation and cytotoxicity after $PM_{2.5}$ exposure has also been determined using the resazurin assay. The reduced glutathione (GSH) assay (Hissin *et al.*, 1976) was employed to evaluate how GSH, one of the primary bio chemicals for cell defence, can be influenced by PM toxicity. In this study the ability of the 3 different concentrations of PM to induce release of the pro-inflammatory mediators, interleukin-6 (IL-6), interleukin-8 (IL-8) and tumor necrosis factor (TNF) from human epithelial lung cells (A549) was investigated. The most potent samples exhibited a relatively high content of transition metals (*e.g.* Fe and Zn); this was especially true for the summer samples of the three sites when looking at IL-6. Significant cytotoxicity was noted only at higher concentrations of particle exposure which would indicate that chemical composition of $PM_{2.5}$ is a critical determinant for the marked differences in potency to induce cytokine responses in human epithelial lung cells. A concentration dependence was noted for the toxicological assays: ROS, IL-6, LDH. However the IL-8 response did not always increase with increasing particle dose over the 5.5-22.0 $\mu g/cm^2$ range. In these cases, the decrease in IL-8 at higher particle concentrations could not be explained by loss of cell viability.

The application of Chemometric methods (*e.g.* Principle Component Analysis), investigated correlations between elemental content (*e.g.* metals) and toxicological endpoints (ROS, IL-6, IL-8…).

This work was supported by the Irish Environmental Protection Agency and 6th Framework Program Marie Curie Transfer of Knowledge Programme.

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Part C) Public Workshop, COST 633, Brussels, March 13-14, 2008

COST 633 MEETING - ANNOUNCEMENT

Particulate matter and health in 2020
Are we on the right track?

Challenges of the changing particulate air pollution in Europe:
what we know and what we should know in the future

13 and 14 March 2008

Brussels, Belgium

(Hotel Leopold, Rue du Luxembourg 35, 1050 Brussels)

Introduction

The revised European Union air quality directive is now on track after the numerous legislative and implementation efforts made in the last few years. During the revision and discussion of this directive, several important issues especially related to particulate matter (PM) were taken up within the Clean Air for Europe (CAFE[1]) Programme. Not all the issues could be tackled in the revision process due to lack of scientific data. There are still major uncertainties and important gaps in the current scientific knowledge that need handling before the next evaluation of the air quality directive in 2013. Stakeholders, policy-makers and decision-makers need further information about the changing PM pollution in Europe. Much more emphasis should be put on the dual impact of PM on health and climate change.

Aims

This two-day meeting aims at providing guidance for dealing with the current heterogeneities and future changes in Europe-wide PM levels and characteristics, as well as the health implications of air pollution and climate change.

Political implications

The legislation on air quality regulates outdoor PM concentrations at fixed sites. However, large differences can exist between these concentrations and the concentrations that people are really exposed to. We know that the distribution of PM over Europe is heterogeneous with regard to mass concentration, physical and chemical characteristics, contributing sources, and related health effects.

- Air quality standards are established to protect human health. How shall we include exposure measurements and modelling in future standards?
- Natural sources such as wildfires and Saharan dusts often cause much pollution in Mediterranean countries. What are the implications for human health?
- Should large quantities of background PM be considered in the evaluation of exceedances?

[1]CAFE is a programme of technical analysis and policy development that underpins the development of the Thematic Strategy on Air Pollution under the Sixth Environmental Action Programme.

- What is the value of alternative indicators for PM mass such as Black Smoke, elemental carbon, particle numbers, and an oxidative stress index?
- Health impact assessment faces the challenge of determining how short-term and long-term exposure affect health and how it relates to other environmental problems. What are the major uncertainties and how can we deal with them?

Structure of the workshop

First day

Scientific discussions in multi-disciplinary expert groups focussing on state-of-the-art questions regarding 'PM and Health':

- Presentation of COST 633 activities and discussion of the main achievements of the Action
- Future effects expected due to changing source patterns, emission characteristics, and chemical pathways caused by current pollution abatement measures and by measures to mitigate climate change.

Critical gaps in knowledge will be summarized and recommendations on how to reduce uncertainties will be formulated as input for the second day.

Second day

Information about the current state of knowledge, the most pressing open questions, and policy guidance for policy-makers and stakeholders.

Presentations

- PM in air pollution, climate change and health
- A policy-maker's views on PM pollution
- PM over Europe – from measurement to modelling and from ambient air to exposure
- Heterogeneities in PM-associated health effects, sources, and PM characteristics
- The Commission's views on PM research related to air quality and health.

Stakeholders and policy-makers are specifically asked to actively participate in the formulation of their scientific information needs for future policy decisions aimed at 2020.

Scientific committee

R. Hitzenberger, AT (chair)
U. Baltensperger, CH
C. Borrego, PT
F. Cassee, NL
S. Fuzzi, IT
T. Kuhlbusch, GE
M. Riediker, CH
R. Salonen, FI
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Program day 1, March 13, 2008

9:00 **Welcome to participants**
Regina Hitzenberger, chair, COST 633

9:15 **Differences and similarities in PM characteristics across Europe: what we learnt and what we might like to know**
Jean-Philippe Putaud, JRC Ispra

9:45 **Heterogeneity in toxicity of particulate matter collected across Europe**
Flemming Cassee (RIVM, Netherlands)

10:15 **Organic aerosols in relation to small-scale wood combustion, forest fires and traffic**
Risto Hillamo, Finnish Meteorological Institute, Helsinki

10: 45 – 11:15 Coffee break

11:15 **Introduction of topics for afternoon breakout group sessions**

11:30 **Inorganic tracers of source pollutions from PM**
Xavier Querol, CSIC, Barcelona

12:00 **New aspects on particulate matter modelling**
Ana Miranda (University of Alveiro) and Wilfried Winiwarter (Austrian Research Centers, Vienna)

12:30 – 14:00 Lunch

14:00 – 15:30 **Breakout group discussions**

15:30 – 15:45 Coffee break

15:45 – 17:00 **Synthesis of results from breakout group discussions**

Program day 2, March 14, 2008

9:00 **Welcome**
Regina Hitzenberger, chair, COST 633

9:15 **PM over Europe – from measurement to modelling and from ambient air to exposure**
Thomas Kuhlbusch, IUTA, Germany

9:45 **Heterogeneities of PM-associated health effects, sources and PM characteristics**
Raimo Salonen, KTL, Finland

10:15 **PM Health Effects - New Directions**
Bert Brunekreef, Utrecht University, NL

10:45 – 11:15 coffee break

11:15 **A policy maker's views on PM pollution**
Peter Bruckmann, Landesamt für Natur, Umwelt und Verbraucherschutz, Recklingen

11:45 **Community-funded research on air pollution and health**
Tuomo Karjalainen, EU

12:15 **Panel Discussion** moderated by *Regina Hitzenberger*

13:00 Lunch