Air Protection in Urban Environment Exchange of Experience

(III Panel discussion of the seminar – air quality analysis – exchange of experience)

Latvian Ministry of Environmental Protection and Regional development, Riga, Latvia

28 April 2016

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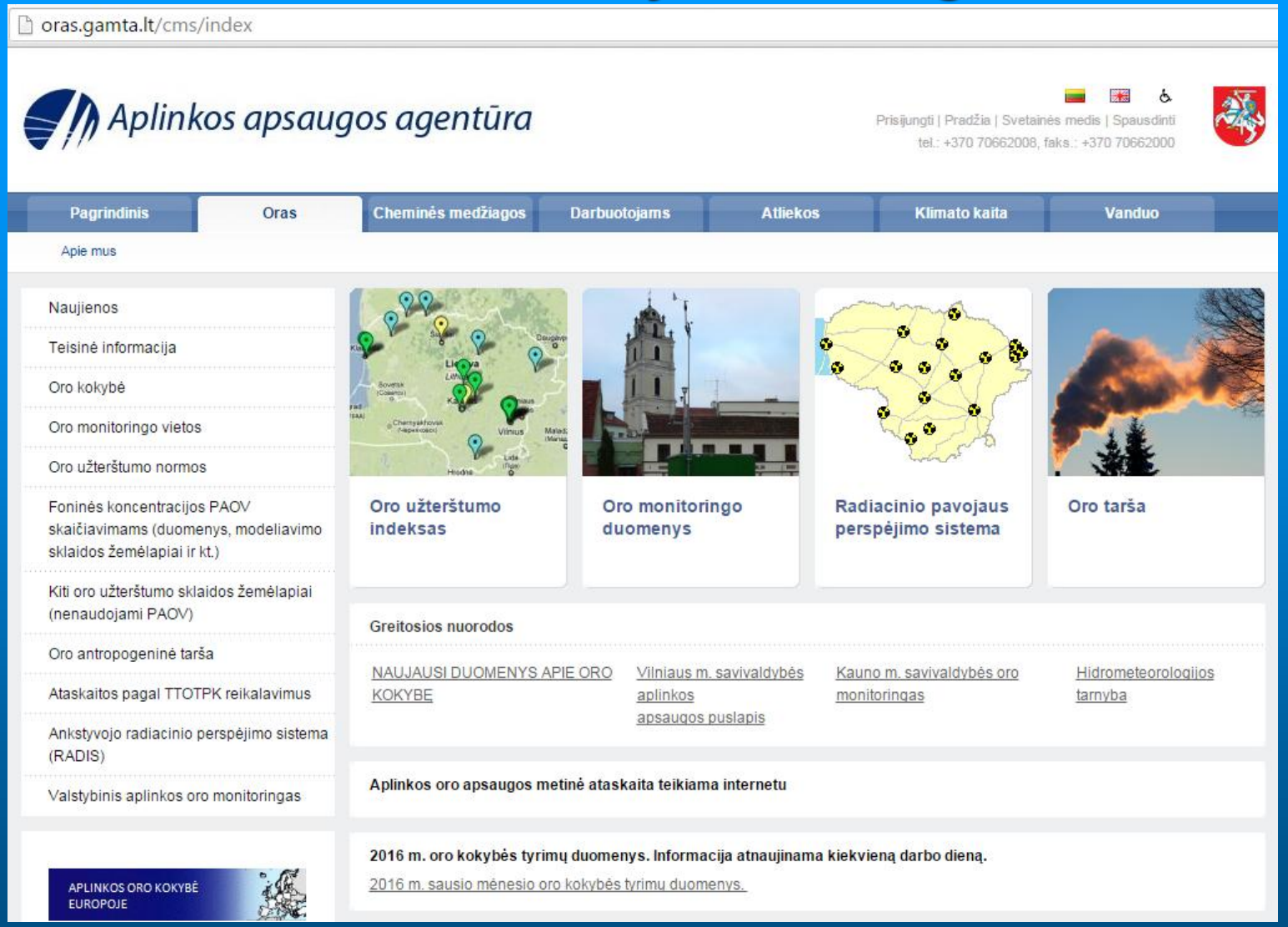
Monitoring, data interpretation and analysis

Environmental Protection Agency, Lithuania

Official Data of Air Quality Monitoring in Lithuania



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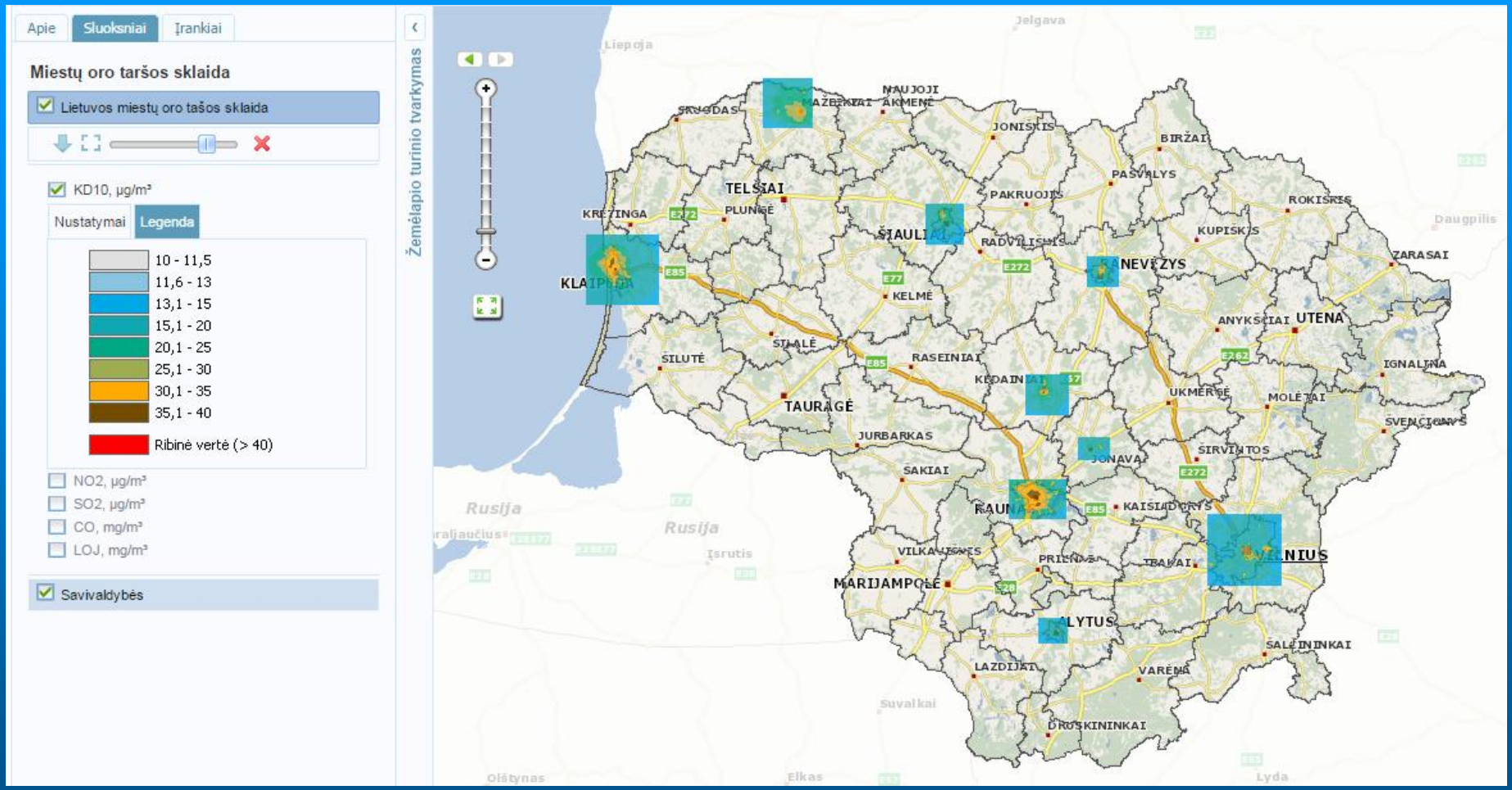
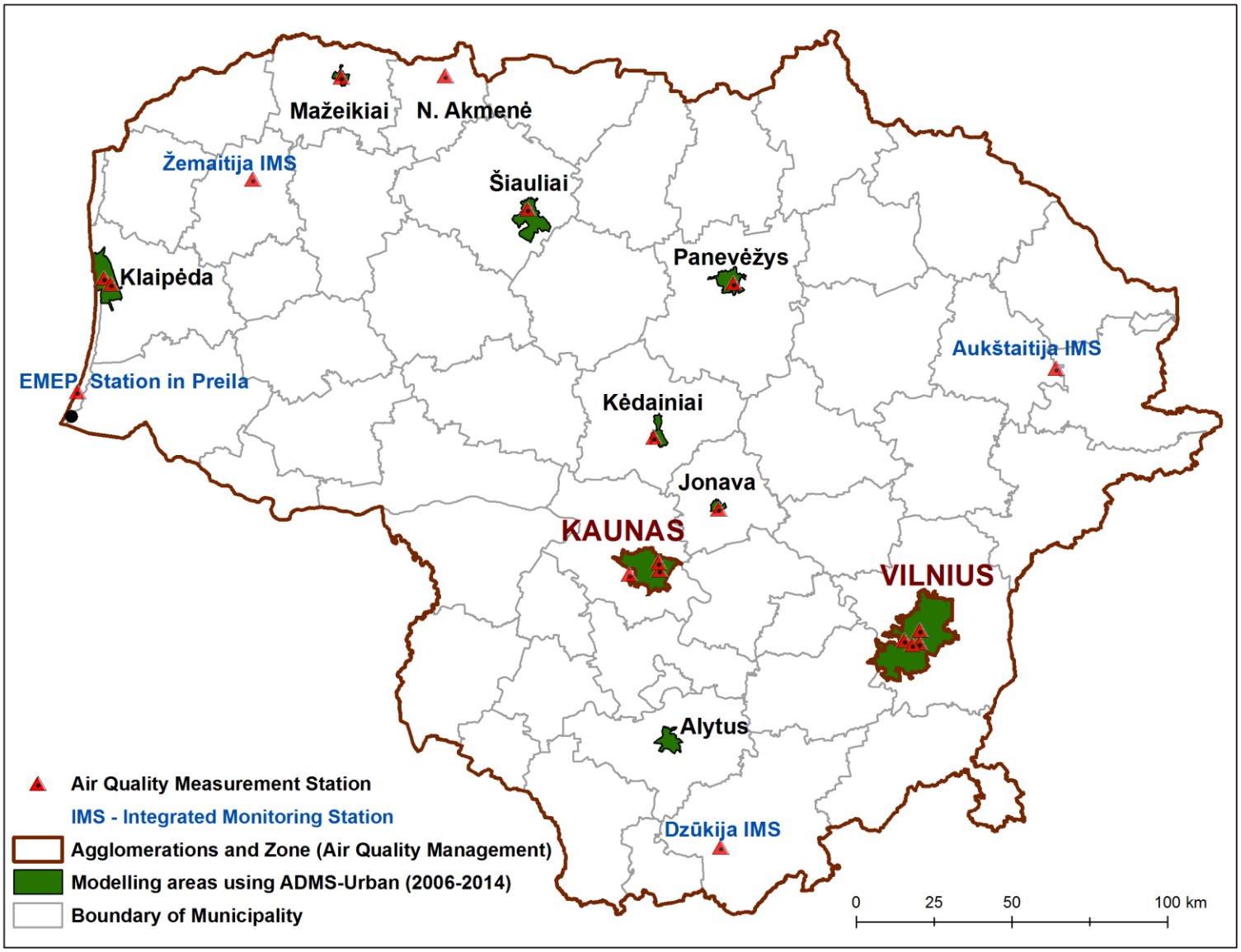
Annual concentrations for the biggest towns in Lithuania ADMS-Urban modelling results (PM10, NO2, SO2, CO, etc.)



ICISEM - Integrated Computerised Information System for Environmental Management
AIVIKS - Aplinkos informacijos valdymo integruota kompiuterinė sistema

https://dts.aplinka.lt/map/viewer/external/#mapId=3151

Network of Lithuanian AQ monitoring stations, 2016



Statistical Data of Air Quality in Lithuania, 2015

Stotis	KD_{10} µg/m³			$KD_{2,5}$ µg/m³	SO_2 µg/m³			NO_2 µg/m³			O_3 µg/m³				CO mg/m³	Benzenas µg/m³
	C_{vid}	$C_{max\ 24\ h}$	P	C_{vid}	C_{vid}	$C_{max\ 24\ h}$	$C_{max\ 1\ h}$	C_{vid}	$C_{max1\ h}$	V	$C_{max8\ h}$	P_1	P_2	$C_{max1\ h}$	$C_{max\ 8\ h}$	C_{vid}
	2015 m. galiojusios normos, ribinės vertės, informavimo bei pavojaus slenkščiai, nustatyti žmonių sveikatos apsaugai															
	40	50	35 d.	25		125	350	40	200	18	120[1)]		25	180/240	10	5
Vilniaus aglomeracija																
Vilnius Senamiestis	30*	103*	31		1,5	9,8	20,0	22*	120*	0					2,9*	
Vilnius Lazdynai	16	67	5		1,8	8,2	21,2	14	118	0	133	4	4	140		0,08*
Vilnius Žirmūnai	39	130	63	23				38	194	0	107	0	2	124	2,2	0,14*
Vilnius Savanorių pr.	23	78	20		2,7	6,1	12,0	21	117	0					2,2	-
Kauno aglomeracija																
Kaunas, Petrašiūnai	27	116	24	14	1,6	6,3	22,6	18	122	0	131	2	1	145	2,7	0,45*
Kaunas, Noreikiškės	20	77	14	10	3,9	18,8	27,8	9	104	0	116	0	0	129	2,4	0,31*
Kaunas, Dainava	27	111	33		1,8	7,3	15,7	21	119	0					1,6	
Zona (Lietuvos teritorija be Vilniaus ir Kauno miestų)																
Klaipėda Centras	28*	94*	20		1,7	4,5	11,4	16	136	0					1,7	0,05*
Klaipėda Šilutės plentas	34	103	34	13				23	148	0	132	1	1	140	1,5	
Šiauliai	21	110	19		1,2	8,5	32,7	21	147	0	113	0	0	123	3,6	
Naujoji Akmenė	20*	59*	2	8	1,9	12,3	31,9									
Mažeikiai	29	102	17		2,9	17,1	117,1	6	68	0	137	7	5	143		
Panevėžys Centras	16	81	10					14	152	0	121	1	1	129	2,2	
Jonava	20	70	6					11	87	0	121	1	2	129		
Kėdainiai	22	81	16		1,8	8,0	34,9	10	68	0	120	0	0	148		0,33*
Žemaitija	11*	58*	2	5*	2,2*	9,7*	32,5*	5*	23*	0	119*	0	1	125*		
Aukštaitija				8							124*	1	2	132*		
Dzūkija					2,2*	4,2*	30,4*	2*	20*	0	127*	3	2	143*		

Stotis	Sunkieji metalai (vidutinė metinė koncentracija)				Policikliniai aromatiniai angliavandeniliai (PAA) (vidutinė metinė koncentracija)					
	Pb, µg/m³	As, ng/m³	Ni, ng/m³	Cd, ng/m³	Benz(a)pirenas, ng/m³	Benz(a)antracenas, ng/m³	Benz(b)fluorantenas, ng/m³	Benz(k)fluorantenas, ng/m³	Dibenz(a,h)antracenas, ng/m³	Inden(1,2,3-cd)pirenas, ng/m³
	Ribinė vertė	Siektinos vertės								
	0,5	6	20	5	1					
Vilnius Žirmūnai	0,003	0,15	0,54	0,07	1,0	1,79	1,13	0,54	0,15	0,90
Kaunas Petrašiūnai	0,004	0,19	0,47	0,12	1,3	1,94	1,33	0,80	0,24	1,20
Klaipėda Centras	0,002	0,14	0,46	0,06	0,7	1,02	0,70	0,35	0,10	0,60
Šiauliai	0,001	0,08	0,41	0,03	0,8	1,44	0,91	0,45	0,11	0,74
Aukštaitija	0,001	0,08	0,34	0,04	0,2	0,27	0,26	0,13	0,04	0,22

Annual average Concentrations of heavy metals in Lithuania, 2013 - 2015 (PM10 filters Directive 2004/107/EU)
Every year: 60 samplers for Metals and 60 samplers for PAH

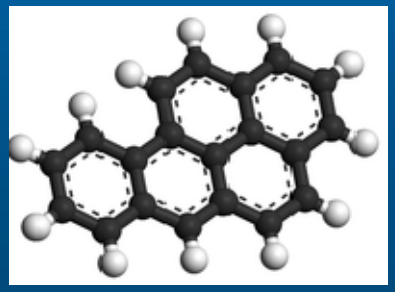
AQM Station	Pb, µg/m^3			As, ng/m^3			Ni, ng/m^3			Cd, ng/m^3		
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015
AUKŠTAITIJA, IMS	0.001	0.002	0.001	0.12	0.14	0.08	0.51	0.27	0.34	0.04	0.05	0.04
VILNIUS, Traffic	0.004	0.004	0.003	0.19	0.22	0.15	0.81	0.67	0.54	0.08	0.08	0.07
KAUNAS, Traffic	0.004	0.004	0.004	0.19	0.22	0.19	0.67	0.44	0.47	0.12	0.10	0.12
KLAIPĖDA, Centre	0.003	0.002	0.002	0.21	0.17	0.14	0.69	0.66	0.46	0.08	0.07	0.06
ŠIAULIAI, Traffic	0.002	0.002	0.001	0.12	0.10	0.08	0.33	0.32	0.41	0.08	0.06	0.03
	3 YEAR AVERAGE											
AUKŠTAITIJA, IMS		0.001			0.11			0.37			0.04	
VILNIUS, Traffic		0.004			0.19			0.67			0.08	
KAUNAS, Traffic		0.004			0.20			0.53			0.11	
KLAIPĖDA, Centre		0.002			0.17			0.60			0.07	
ŠIAULIAI, Traffic		0.002			0.10			0.35			0.06	
		Pb			As			Ni			Cd	

Limit value for Pb 0,5 µg/m^3
Target values for As 6 ng/m^3; Ni 20 ng/m^3; Cd 5 ng/m^3

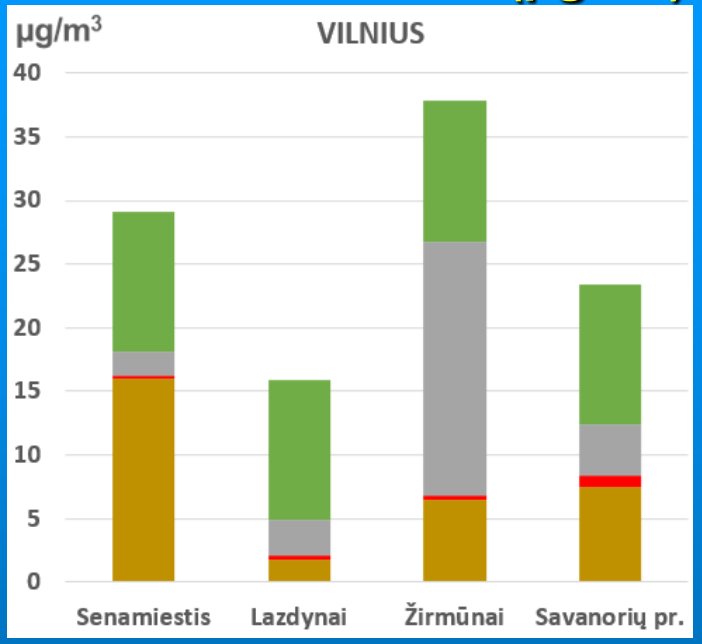
Seasonal Benzo(a)pyrene Concentrations (ng/m^3) in Lithuania, 2013 - 2015

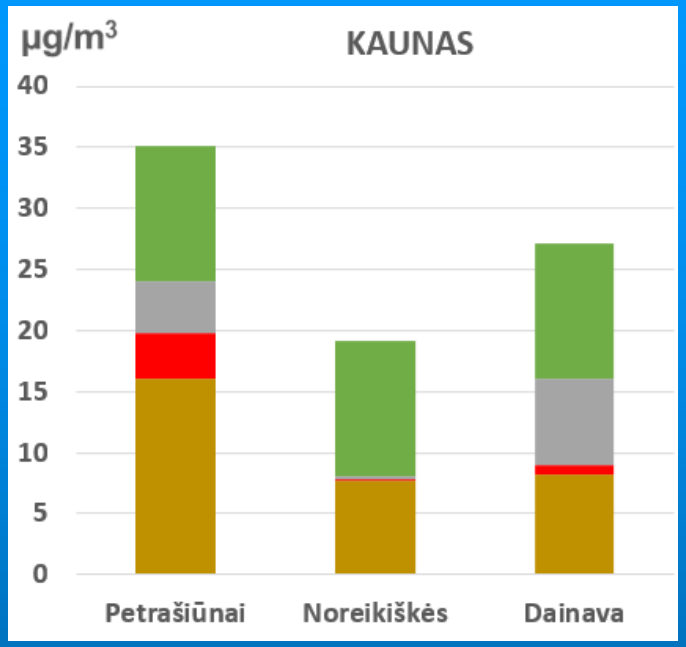
AQM Station	Winter			Spring			Summer			Autumn			Annual		
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015
AUKŠTAITIJA, IMS	0.61	0.55	*0.58*	0.11	0.14	0.14	0.03	0.04	0.02	0.18	0.21	0.11	0.2	0.2	0.2
VILNIUS, Traffic	2.81	2.11	*2.8*	1.02	0.53	0.41	0.08	0.05	0.09	0.75	1.95	*0.76*	1.2	1.2	1
KAUNAS, Traffic	4.62	3.0	*2.84*	1.39	0.97	0.75	0.14	0.14	0.13	0.97	1.41	*1.52*	1.8	1.4	1.3
KLAIPĖDA, Centre	4.06	2.26	*1.4*	1.31	0.39	0.22	0.03	0.03	0.03	0.57	1.05	*0.68*	1.5	0.9	0.7
ŠIAULIAI, Traffic	4.61	3.23	*2.2*	1.2	0.62	0.38	0.25	0.05	0.05	0.98	1.61	0.98	1.8	1.4	0.8
	3 YEAR AVERAGE														
AUKŠTAITIJA, IMS		0.58			0.13			0.03			0.17			0.2	
VILNIUS, Traffic		2.57			0.65			0.07			1.15			1.1	
KAUNAS, Traffic		3.49			1.04			0.14			1.30			1.5	
KLAIPĖDA, Centre		2.57			0.64			0.03			0.77			1.0	
ŠIAULIAI, Traffic		3.35			0.73			0.12			1.19			1.3	

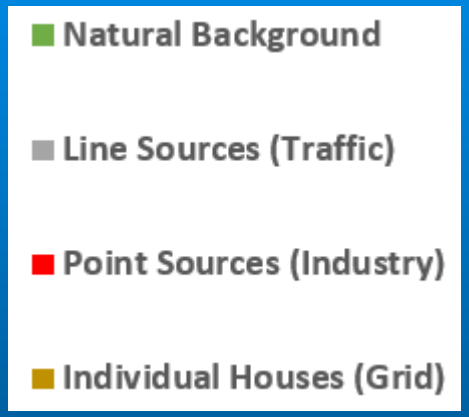
Target value for benzo(a)pyrene 1 ng/m^3

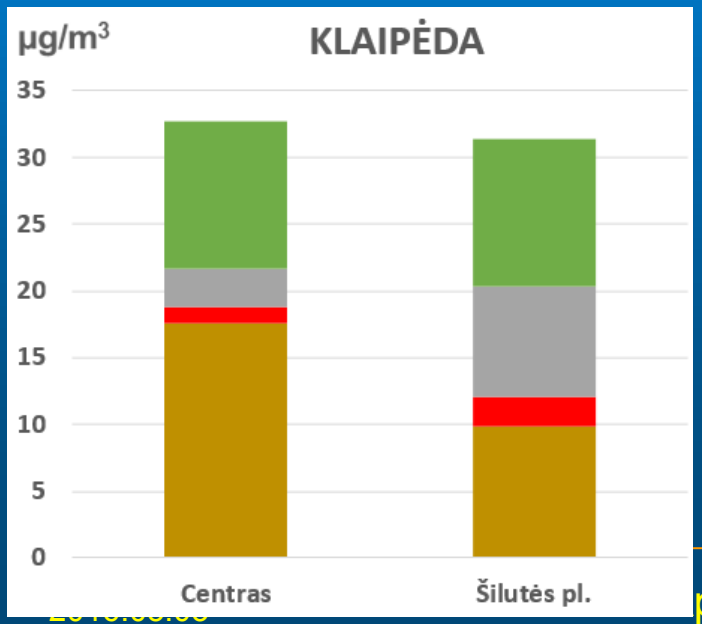


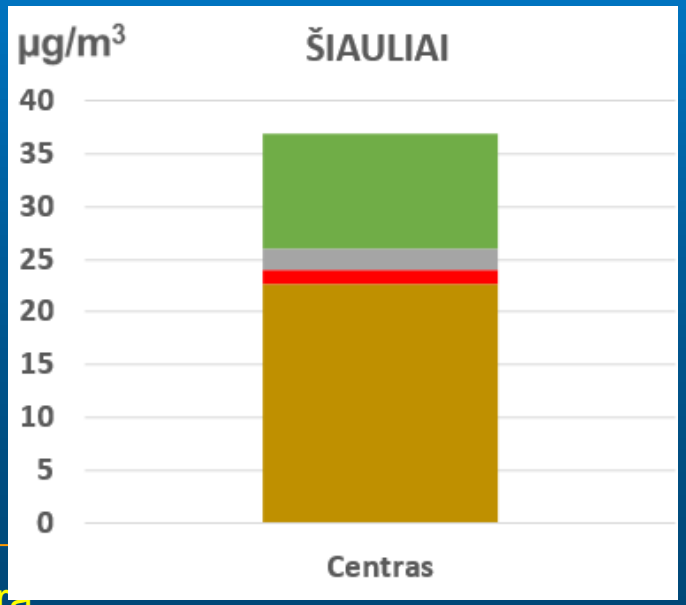
Different Air Pollution Sources Input to the Average Annual PM10 Concentration (μg/m³) at the Biggest Towns Of Lithuania (2013)





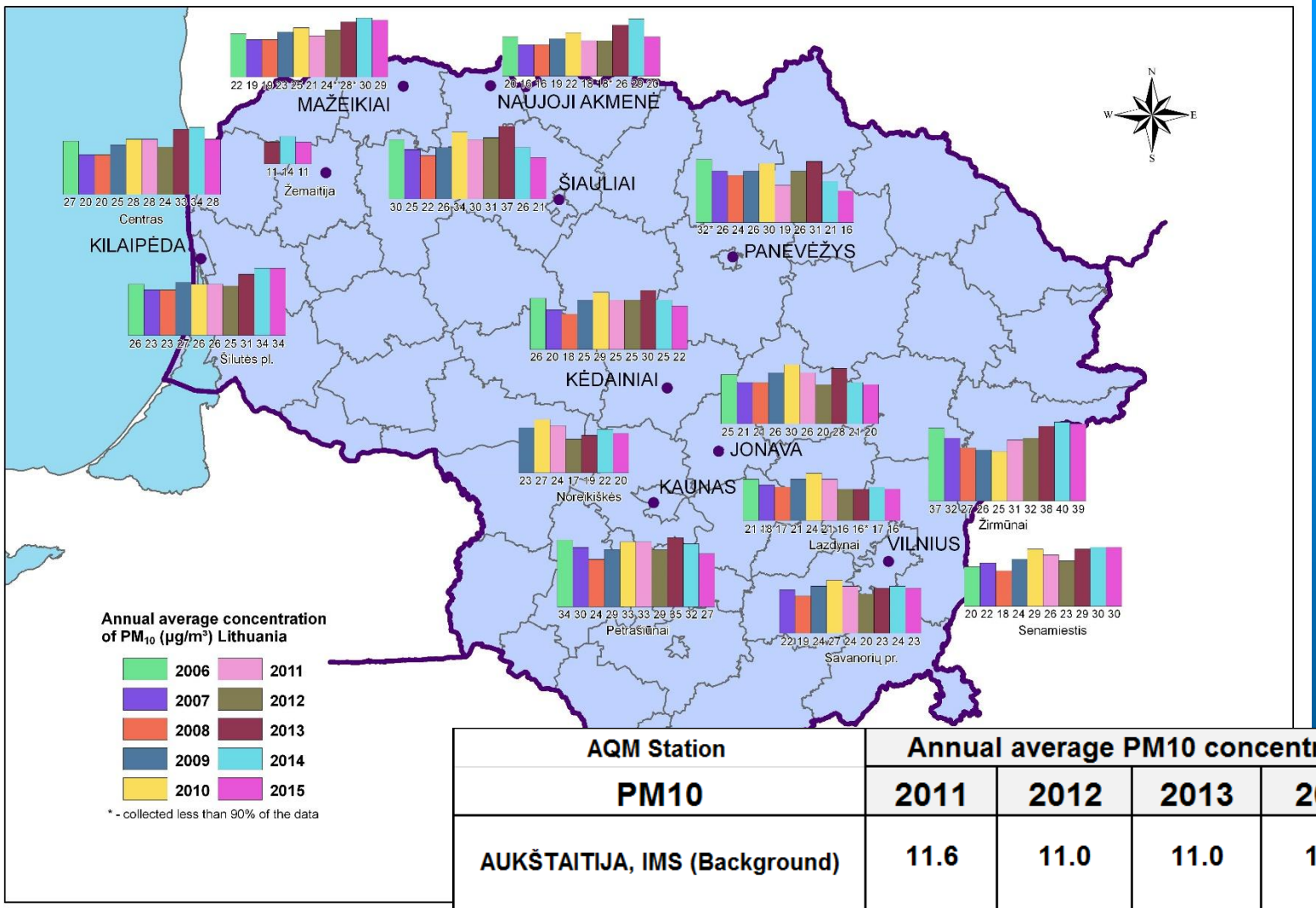






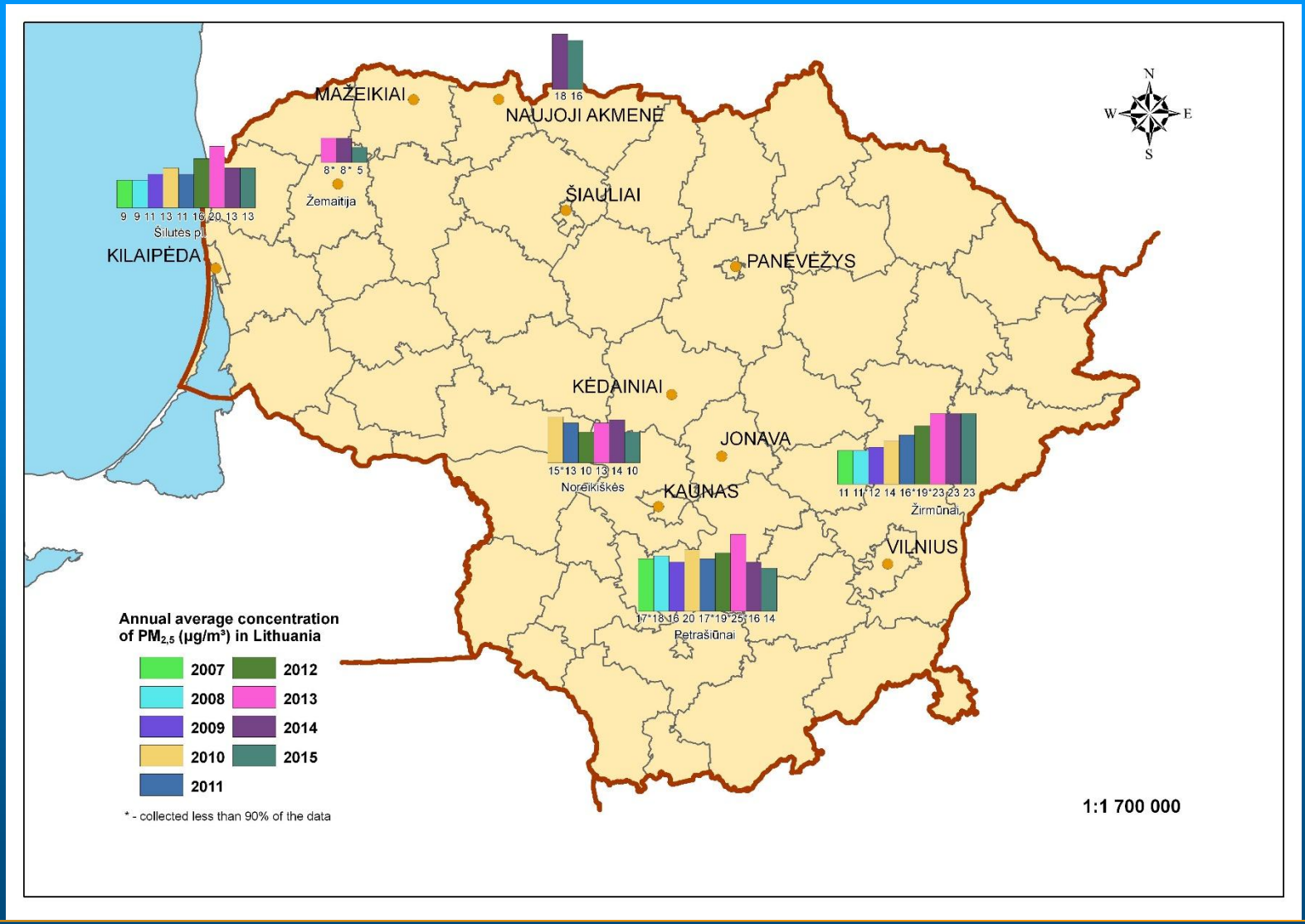
plinkos apsaugos agentūra

Annual Average PM10 Concentrations (μg/m^3) in Lithuania, 2006 – 2015



AQM Station	Annual average PM10 concentration, μg/m3				
PM10	2011	2012	2013	2014	2015
AUKŠTAITIJA, IMS (Background)	11.6	11.0	11.0	13.6	10.6
VILNIUS Lazdynai (Background)	20.6	15.9	15.9	17.1	15.5

Annual Average PM10 Concentrations (μg/m³) in Lithuania, 2007 – 2015

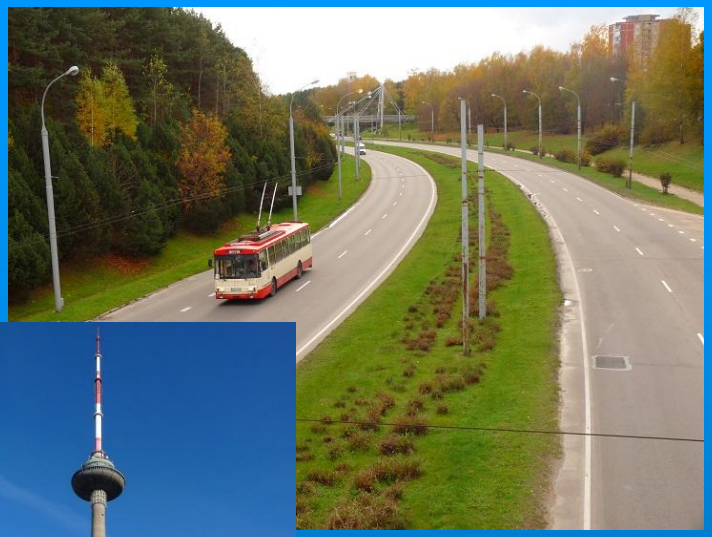


Vilnius, Lazdynai (Background) AQM station

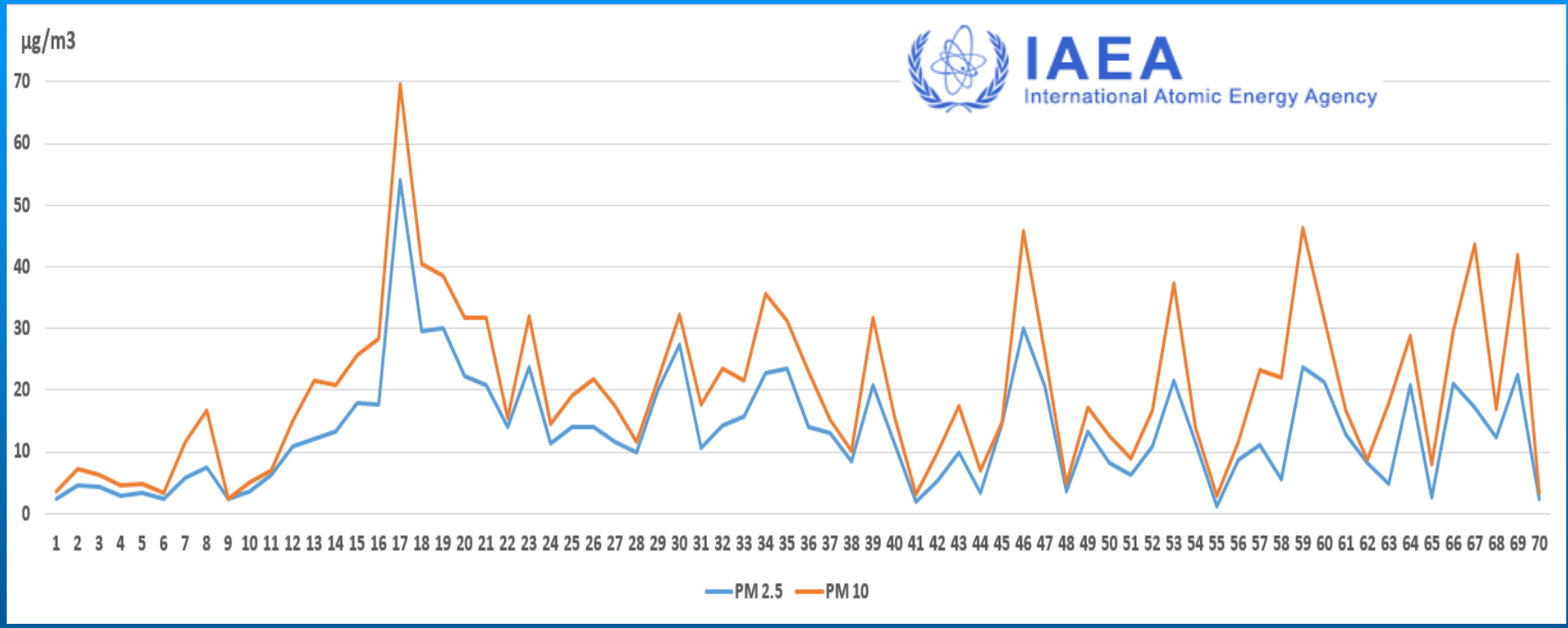
54°41'10"N, 25°12'39"E
LAT 54.6861
LONG 25.2108
ALT. 170 m

Environnement S.A

Vilnius Background AQMS Environment



PM2.5 Concentrations (µg/m^3) Derived From 70 filters
PM10 concentrations (µg/m^3) from Vilnius Background AQMS
Period: 2014.08.16 – 2015.04.01 (IAEA Project RER/1/013/)

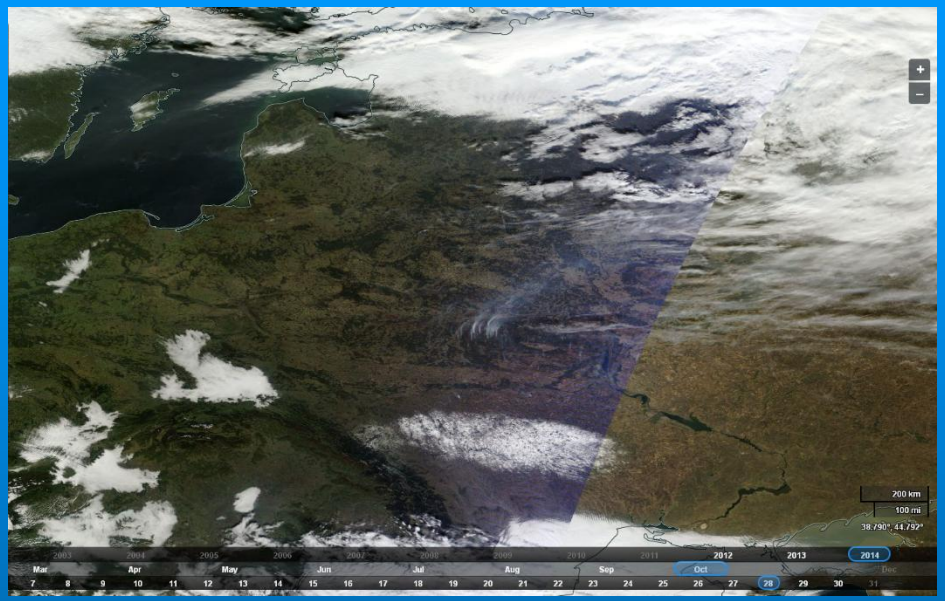


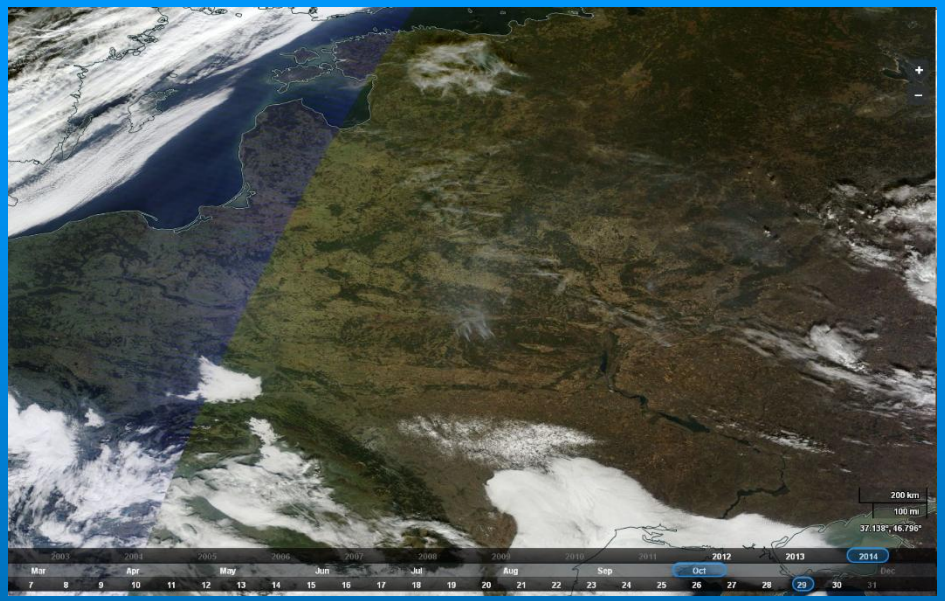
Average PM2.5 / PM10 Concentrations (µg/m^3) autumn 13.9 / 19.5
Average PM2.5 / PM10 Concentrations (µg/m^3) winter 13.0 / 19.8
Average PM2.5 / PM10 Concentrations (µg/m^3) spring 12.4 / 22.1

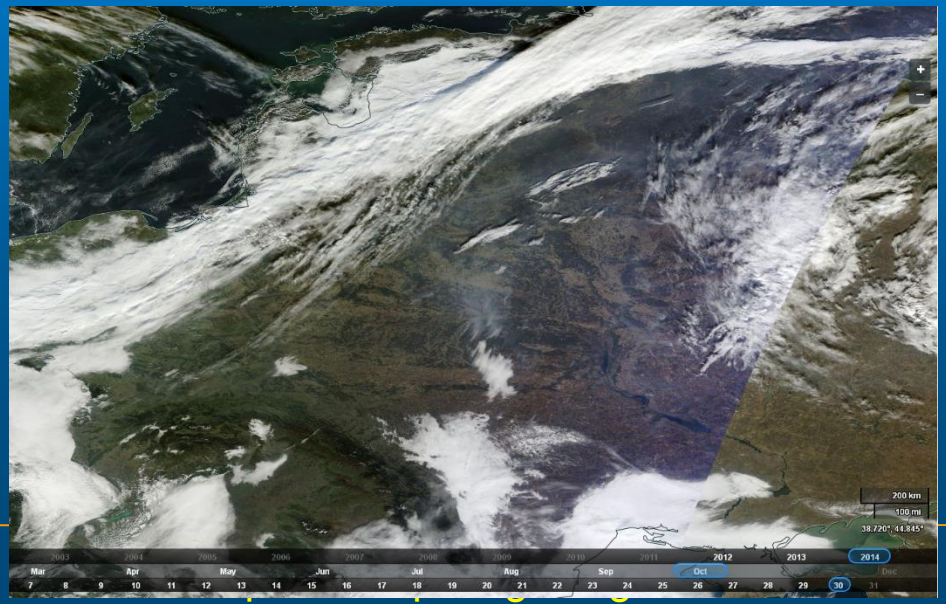
Results Of Measured PM10 and PM2,5 Concentrations 2014 October 28-30

START sampling	STOP sampling	Exp. Hours	Holder No.	Q, m3	Air Temp, °C	Wind Speed, m/s	Pressure at site level, hPa	Pressure at sea level, hPa	Rel. Hum., %	Precip., mm	PM10, µg/m^3	PM2.5, µg/m^3
2014-10-26 13:25	2014-10-27 13:25	24.0	14	22.0	2.7	3.8	1011.3	1031.0	62.3	0.0	20.9	13.2
2014-10-27 13:30	2014-10-28 13:30	24.0	15	22.0	5.1	3.7	1009.7	1029.2	67.6	0.0	25.7	18.0
2014-10-28 13:35	2014-10-29 13:35	24.0	16	22.0	4.6	3.5	1006.4	1025.9	46.4	0.0	28.2	17.7
2014-10-29 13:40	2014-10-30 13:40	24.0	17	22.0	3.4	3.1	1002.5	1022.0	60.4	0.0	69.7	54.1
2014-10-30 13:50	2014-10-31 13:55	24.1	18	22.1	5.0	1.6	1005.4	1024.8	87.1	0.0	40.5	29.7

Natural Fire Impact to PM10 and PM2,5 Concentrations 2014 October 28-30







PIXE Analysis from 50 PTFE 46.2 mm Ø, 2 µm pore size filters Period: 2014.08.16 – 2015.01.20

Max, Min, Mean concentration (ng/m^3) of 16 Elements Were Identified

	PM 2.5	Al	Si	P	S	Cl	K	Ca	Sc	Ti	Cr	Mn	Fe	Ni	Cu	Zn	Pb
MAX	54,1	559	316	54	2334	1324	1157	102	8	9	7	7	104	3	13	73	15
MIN	1,8	4,7	2,2	0,0	15,6	0,9	8,5	0,8	0,69	0,09	1,03	1,13	1,99	0,53	0,65	0,89	3,98
MEAN	14	139	71	6	676	94	204	32	1	3	2	3	40	1	2	21	6

Other filters were not analyzed for period 2015.01.24 – 2015.04.01 Measurements are continuing from 2015.09.30 to at least 2017.03.01

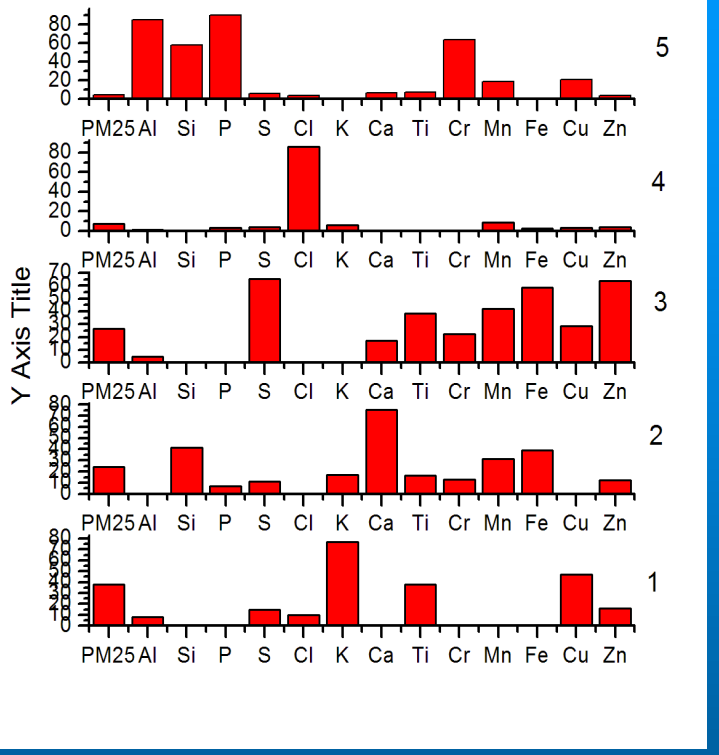
	Domination of elements, % of weighted average	Main source(s)
K	13	Biomass burning
Ti	11	Soil particles, mineral dust
Cu	10	Traffic, soil particles
Zn	10	Traffic, soil particles
S	10	Secondary aerosol formation
Fe	10	Traffic, soil particles
Ca	9	Soil particles
Mn	8	Industry, soil particles
Si	5	Soil particles, mineral dust
Cr	5	Industry, soil particles, mineral dust
Cl	4	Biomass burning, remote pollution
Al	3	Mineral dust
P	2	Mineral dust

POLLUTION SOURCE	INCOME	CAN WE CONTROL OR ACHIEVE A POSITIVE EFFECT TO REDUCE AIR POLLUTION?
Soil particles and mineral dust		YES; NO
Biomas Burning	78%	YES
Traffic		YES
Secondary aerosol formation		YES; NO
Industry	22%	YES
Long range pollution		NO

IAEA International Atomic Energy Agency

PMF Run 5 Factors Were Identified From 50 Samplers Of Sampling Period: 2014.08.16 – 2015.01.20

Factor Profiles (% of species sum) from Base Run #16 (Convergent Run)						
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Sum, %
PM2.5	37.9	23.9	26.3	7.2	4.7	100
Al_conc	8.191	0	4.946	1.333	85.530	100
Si_conc	0.300	41.562	0	0	58.138	100
P_conc	0	6.769	0	2.919	90.313	100
S_conc	14.499	10.922	65.358	3.590	5.632	100
Cl_conc	9.950	0.078	0.035	85.863	4.074	100
K_conc	77.014	17.108	0	5.878	0	100
Ca_conc	0	75.118	17.172	0.743	6.967	100
Ti_conc	37.753	16.218	38.351	0	7.678	100
Cr_conc	0	13.075	22.428	0.744	63.753	100
Mn_conc	0	31.422	41.818	8.346	18.414	100
Fe_conc	0.160	39.067	58.413	2.360	0	100
Cu_conc	46.860	0	28.655	3.483	21.002	100
Zn_conc	15.922	12.418	63.837	3.940	3.884	100



Factor (F) Contributions:

F1 Biomass burning 38% (K; Cu; Ti)

F3 Secondary formation of aerosol particles & Traffic 26% (S; Zn; Fe)

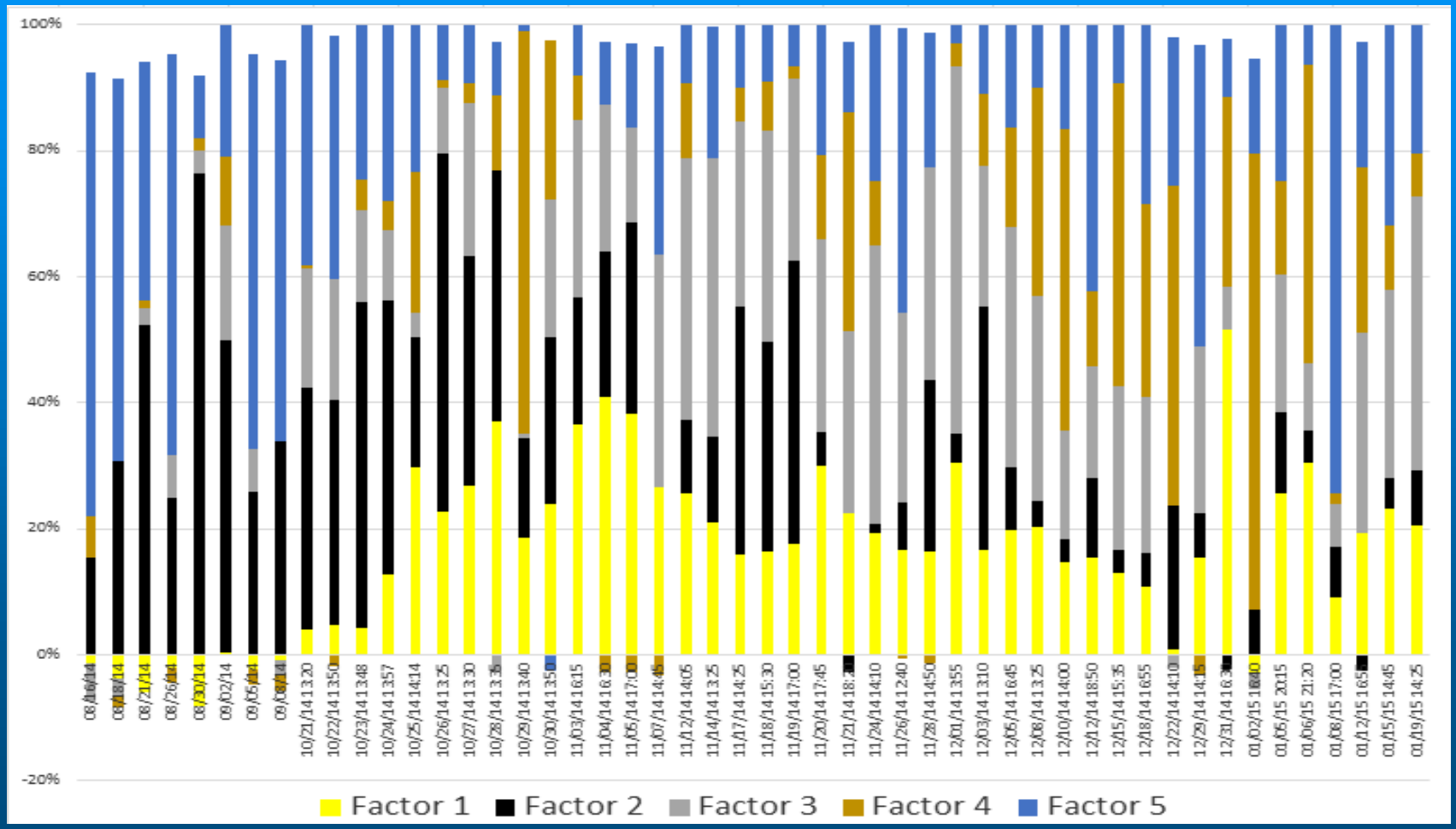
F2 Local natural dust (soil particles) 24% (Ca; Si; Fe; Mn)

F4 Long range pollution, industry, forest fire 7% (Cl; Mn; K)

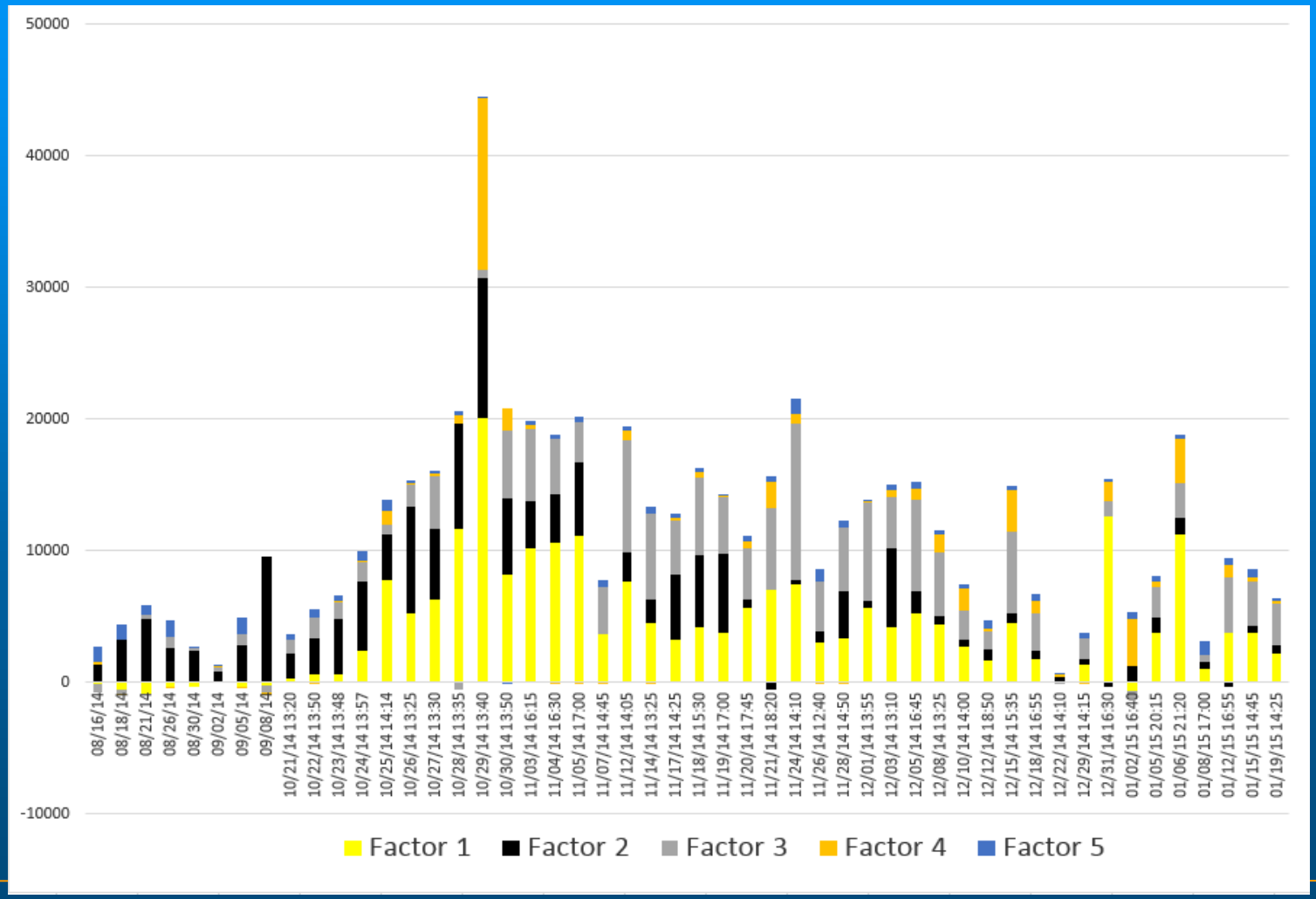
F5 Mineral dust 5% (P; Al; Cr; Si)

Sampling Period: 2014.08.16–2015.01.20 at Vilnius background AQMS - analysis of 50 samplers

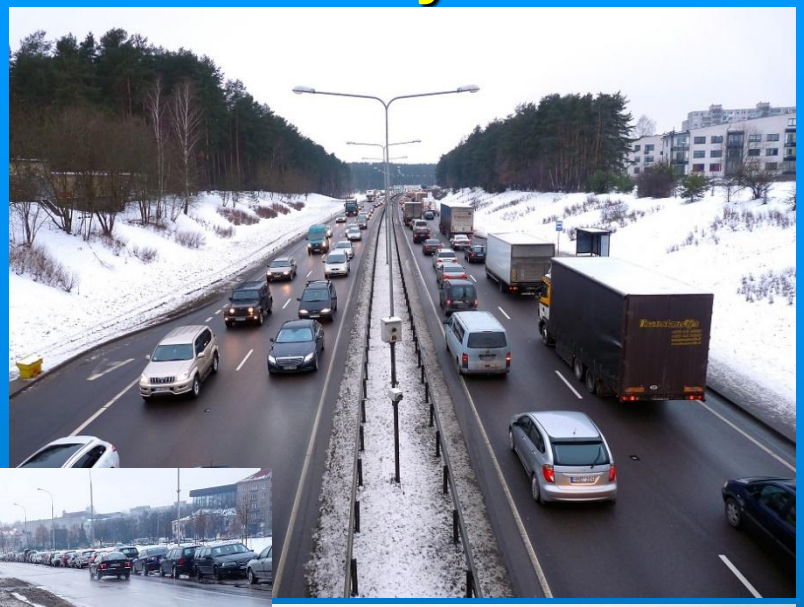
Factor Contributions (avg = 1) from Base Run #16 (Convergent Run)



Sampling Period: 2014.08.16–2015.01.20 at Vilnius background AQMS - analysis of 50 samplers
Factor Contributions (conc. units) from Base Run #16 (Convergent Run, Total Variable of PM2,5)



Main APM Sources in Vilnius City



Conclusions

1. Modelling of 9 cities terrain covers only about 5% of teritory of Lithuania, but there lives up to 50% of all country population.
2. According to the data from 10 AQMS in 4 biggest cities and modelling data of 2013, source apportionment to PM10 average annual concentration distributes following: residential combustion and commercial heating 39%, natural background 38%, road traffic (without secondary pollution) 19%, industry (including central heating) 4%.
3. According to the PMF Run for 2014 Autumn – 2015 Winter season in Vilnius, Factor contributions of PM2,5 concentration are as follows: Biomass burning 38%, Secondary formation of aerosol particles & Traffic 26%, Local natural dust (soil particles) 24%, Long range pollution and industrial sources 7%, Mineral dust 5%.
4. For more precise interpretation of the results from PMF analysis we need to continue sampling and analysing at least 120 filters covering all the year.
5. Benzo(a)pyrene as a product of combustion is a problematic substance (can not meet the target value). It‘s nesessary to control...

Thank you !

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