CI&CEQ

Available on line at
Association of the Chemical Engineers of Serbia *AChE*
www.ache.org.rs/CICEQ

Chemical Industry & Chemical Engineering Quarterly 18 (4) 605–615 (2012) CI&CEQ

ALENA BARTOŇOVÁ[1]
MILENA JOVAŠEVIĆ-STOJANOVIĆ[2]

[1]NILU Norwegian Institute for Air Research, Kjeller, Norway
[2]Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

REVIEW PAPER

UDC 614.7:502:504.5(497.11)

DOI 10.2298/CICEQ121125124B

INTEGRATED ASSESSMENT AND MANAGEMENT OF AMBIENT PARTICULATE MATTER – INTERNATIONAL PERSPECTIVE AND CURRENT RESEARCH IN SERBIA

Air pollution mitigation is a necessity in Serbia, due to its high levels of criteria pollutants in ambient environment. Successful implementation of mitigation measures requires access to sufficient information from national research, and well running and efficient local participatory processes. To support air pollution mitigation in the West Balkan region, the WeBIOPATR project started a series of bi-annual conferences in 2007. They bring together an inter-disciplinary research community and local and national administrations from Serbia and its neighbourhood, to present research results from Serbia and countries all over the world, and to share knowledge and best practices of mitigation. The conferences promote research that may support integrated assessment of particulate matter, and further refinement of the "Pressures-State-Impact" (PSI) part of the "Drivers-Pressures-State-Impact-Response" (DPSIR) framework. Integrated approach needs to be underpinned by solid disciplinary research covering, e.g., air quality monitoring technologies, atmospheric and further ambient composition, atmospheric modelling, biological effects and human health. WeBIOPATR conferences report on recently performed studies of particulate matter in Serbia and abroad. Through the breadth of subjects and audience, they bring together a wide inter-disciplinary and cross-sectoral expertise in support of translation of research to practice. They also allow to present examples of successful mitigation achieved with the help of strong local participatory environmental governance, demonstrating the increasing recognition of the need to involve both public and private actors. This paper gives the main features of a full chain approach and elements of integrated approach to particulate matter research, summarizes the proceedings of the 3rd WeBIOPATR conference, and in addition, reviews the results of particulate matter monitoring and source identification studies in Serbia since the monitoring start ten years ago.

Keywords: particulate matter; integrated assessment; sources; modeling; exposure; health effects.

BACKGROUND AND AIM OF THE CONFERENCE

In Europe, air quality is regulated by legislative instruments developed in broad consensus process going back several decades. The legislation aims at protecting human health and natural ecosystems. Particulate matter (PM) is one of the main air pollutants, receiving attention due to its documented adverse effects on human health. Despite the long-term focus, levels of particulate matter remain above the set limit values in many areas. This is due to increasing activities in economic sectors that contribute to particulate pollution, as well as to natural processes and events. Mitigation requires thorough scientific understanding of the issues, and a wide collaboration of legislators and administrators with the society, including economic actors, civil society and research.

Correspondence: A. Bartonova, NILU Norwegian Institute for Air Research, P.O. Box 100, N-2027 Kjeller, Norway.
Paper received: 25 November, 2012
Paper accepted: 26 November, 2012

PM arising both from primary emissions and as a result of secondary formation in the atmosphere is an extensively studied, but still not sufficiently understood, atmospheric pollutant. In the EU, the legislation development, implementation, societal acceptance and the underlying research on PM in outdoor and indoor environment have long tradition. In the West Balkan countries, including Serbia, only total suspended particles (TSP) were recognized as a criteria pollutant for a long time, and smaller fractions of PM, measured and regulated elsewhere, have received less attention. In the last decade, superposition of the EU legislation and the need to find practical ways to implement it changed focus from TSP to PM and its fractions, and has brought about a number of activities [1]. The WeBIOPATR project (2006-2009) aimed at generating data on PM, and at supporting communication between all actors in Serbia through workshops/conferences. The third conference (2011) continued the bi-annual cycle, after the initial project was completed.

The conferences [1-4] address atmospheric PM, the air quality constituent that is currently responsible for most instances of non-compliance with air quality directives in Europe. They aim to provide insight into integrated assessment and to support successful PM mitigation. They also provide the much needed communication platform for exchange of views and perspectives between the regulatory and the research community in Serbia. Such platform can serve as a link and a mediator that provides for the necessary discussions [5], thus facilitating uptake of research results by the decision making community and increasing the understanding by the research community of the decision-makers perspectives.

This article defines the framework for management of PM, summarises the conference contributions that include results of all recent relevant Serbian research projects, and provides an overview of PM levels measured in Serbia since the start of PM monitoring in 2002.

INTEGRATED ASSESSMENT FRAMEWORK WITH DETAILED EXPOSURE ASSESSMENT

Air quality management was introduced in a keynote lecture outlining practical steps in air quality management and giving a summary of European current practice [6], and providing a methodological background and an integrating framework. Successful mitigation of PM problem requires understanding from many disciplines, and this poses great challenges to both disciplinary skills and communication between different participants. Insights into problems that arise in the communication process are provided by Keune *et al.* [7]. The authors illustrate the different perspectives of the scientists and of the decision-makers, and offer guidance on how these perspectives can be taken into account for the benefit of providing lasting solutions. A common framework helps both to define an understandable structure within which to address each problem, and to effectively communicate across professions [6].

Frameworks used for assessments that support mitigation of air pollution were reviewed e.g. by Liu *et al.* [8]. The authors put weight on the need to protect human health, and identify the necessary information and knowledge elements and available technical tools. Several examples of integrated assessment as a support to design strategies for mitigation of air pollution can be found in the literature, perhaps starting from the Rains model [9] and the ExternE project [10] that have laid basis for modern European air quality legislation. This kind of “integrated assessment” is closely linked with economic assessment of the costs and benefits of mitigation measures. The “integration” follows the “Drivers-Pressures-State-Impact-Action“ [11] approach that allows building an operational model to address the expected effects of pollution mitigation scenarios on human health and ecosystem status. To assess the links between environment and health requires further refinement of the “Pressure-State-Impact” part of the framework, and more emphasis on the societal involvement. This can be done in a framework of Integrated Environmental Health Impact Assessment (IEHIA) [12].

In the recently completed HEIMTSA project [13], the research basis for outdoor air quality management was reviewed and complemented. HEIMTSA suggests using a methodology closely linked to the IEHIA, the “full chain approach”, *i.e.*, strengthened “people”- related element in the assessment: the social and economic context, individual and group behaviour, and perceptions of risk. In common with the IEHIA approach, this extension of integrated assessment highlights the development of an exposure assessment. Exposure links the environmental status (air quality) and effects. Allowing for differences in exposure patterns and health responses between groups or individuals allows development of mitigation strategies that protect vulnerable groups. Controlling the levels to which individuals are exposed by limiting the contact of individuals or special groups with air pollution, *e.g.*, by providing air pollution warnings or by suggesting alternative behaviour, is a widely used approach that complements the control of pollution through minimizing emissions at the source.

The HEIMTSA team has also developed an example [14,15] that quantifies the effect of concentration gradients of gaseous compounds between background and "hot spots", and the effect on the overall exposure of different time spent by different population groups in certain micro-environments (outdoors, in traffic, at home and at work). An exposure scaling factor, ESF, is calculated based on a combination of data on time spent in the selected microenvironments by different demographic groups (by gender, age groups, employment status); it is a weighted average of concentrations in given microenvironments, with weights corresponding to the time spent in each microenvironment, specific for each population group. The population data are derived from European-level datasets from the Harmonized European Time Use Survey, HETUS [16], and the Multinational Time Use Study, MTUS [17]. Furthermore, the ESF utilizes the fact that both HETUS and MTUS provide individual level data, and allows a presentation as a probability distribution. Gerharz *et al.* [14] estimated that seniors (65 years of age and older) have clearly the lowest exposure values, while children are exposed the most: their median exposure is about twice as high as that of seniors. This has wide implications for public health, and should lead to special mitigation measures: children are considered an especially vulnerable population group with respect to air pollution, and this result indicates that they are the most highly exposed.

The example of exposure scaling factor also illustrates how exposure assessment often needs to draw on different kinds of information sources and techniques, ranging from sociological data on population behaviour to modelled data on future air quality derived from advanced European-level dispersion modelling. Linking these data is not trivial. A number of sources of data exist, not least the European database ExpoFacts [18]. Work on exposure scaling factor provides a good insight into the complexities of population exposure, and it clearly illustrates the need to differentiate between different population groups when designing mitigation strategies for air pollution.

Indoor air quality

While the relationships between outdoor air pollution levels and health are beyond doubt, the role of indoor environment receives less research attention. A recent EU FP6 research coordination action EnVIE [19] has reviewed the state of knowledge as well as means to address the issue. One of the challenges is an understanding of formation of secondary aerosols in indoor air [20].

The indoor environment is legislatively a difficult one due to the many public and private actors involved [21]. In addition, information about indoor air quality is generally lacking, and there are almost no attempts to set up systematic monitoring programs. A recently funded European Observatory on Indoor Air SINPHONIE [22] is developing a monitoring framework and collects data for assessment of health-related aspects of European schools. Several related projects are also in place in Serbia. The ratio of concentrations in indoor and outdoor kindergarten microenvironment located in the city centre of Belgrade next to a busy street was investigated for pollutants specific for traffic urban environment (PM_{10} and $PM_{2.5}$, priority PAHs and metals and metalloids) [23] while metals, metalloids and secondary aerosol were analysed representing exposure in kindergarten located in a vicinity of a copper smelter in the city of Bor, and in a traffic exposed area of Niš [24,25].

ATMOSPHERIC MONITORING AND MODELLING AS A BASIS FOR MITIGATION

Air quality monitoring and modelling are the two main methods used to assess the levels and trends in air pollution. On regional basis in Europe, the European Monitoring and Assessment Program [26] provides an assessment framework for PM that combines monitoring and atmospheric dispersion modelling in an integrated assessment framework [27]. The program is in operation since 1972, with PM (as PM_{10} and $PM_{2.5}$) measurements going back to mid-1990s [28]. The modelling done in this program was presented by Tsyro [29]. In urban areas, monitoring is done on the basis of the Clean Air for Europe thematic strategy resulting in the Directive 2008/50/EC [30] on ambient air quality and cleaner air for Europe that specifies standards for both PM_{10} and the potentially more health relevant fraction $PM_{2.5}$. A comparison of the regional background measurements of EMEP with the urban background $PM_{2.5}$ data reported in the European Air Quality Database – AirBase [31] shows that more than 60% of the urban background concentration is likely to be attributed to the rural background contribution [32]. While regional levels of PM have been somewhat reduced over time [27], there is a wide non-compliance with the air quality standards for both PM fractions in urban areas [33]. In Serbia, the recently finished twinning project "Strengthening Administrative Capacities for Implementation of Air Quality Management System" (autumn 2009-spring 2012) will undoubtedly contribute to the improvement of implementation of Air Quality legislation [34,35].

PARTICULATE MATTER LEVELS AND SOURCE CONTRIBUTION IN SERBIA

Serbian ambient PM monitoring at state and local level and research projects that measured PM on campaign basis were reviewed in connection with the 2nd WeBIOPATR workshop [1]. Currently, automatic monitoring networks in Serbia operate at national level under the Serbian Environmental Protection Agency (SEPA) [36], and at local level in two areas under the Province of Vojvodina Secretary of Urbanism, Construction and Environmental Protection [37] and under the Municipality of Belgrade [38]. The number of PM_{10} monitors is similar in 2012 as in 2009 [1]. Table 1 summarizes 24 h levels and number of exceedances of limit values at automatic monitoring stations in Serbia in 2010 and 2011 [39,40]. Since 2010, three additional PM monitoring stations were established in industrial areas. In the southern and western part of Serbia, there are no urban sites equipped with PM automatic monitors.

Table 2 presents levels of PM fractions $PM_{2.5}$ and PM_{10} on available urban automatic monitoring sites (Zrenjanin and Novi Sad) or during campaigns (Zrenjanin, Bor, Vršac, Kikinda and Belgrade) performed in Serbia during the last decade [23-25,41-48].

Compared to EU countries, there is a lack of PM data from Serbian rural areas. Tasic *et al*. [49] compare PM_{10} and $PM_{2.5}$ in urban industrial area and in its rural surroundings. There is a significant seasonal difference in $PM_{2.5}$ levels on all rural sites, because they are affected by domestic heating emissions in cold periods. PM levels in the urban area of Bor are more influenced by the air pollution from the Copper Smelter Complex than by rural settlements.

Source contribution, regional transport and health effects can be determined from a more detailed analysis of PM. Prior to 2002, there is no PM_{10} data in Serbia. Mijić *et al.* [50,51] present results of receptor modelling based on 10 metals analyzed in PM_{10} fraction collected on 3 sampling sites in Belgrade in 2003--2006. Using the Unmix model, they identified 4 factors, representing contribution to PM concentrations from fossil fuel combustion, traffic exhaust, regional transport from industry in the surroundings of Belgrade and mineral/crustal matter. A PM database with metals, cations and anions from a later period was similarly analyzed applying Unmix by Joksic *et al.* [52] and applying PMF by Cvetkovic *et al.* [53]. For the first time in Serbia, the later assessed source contribution to PM_{10} and PM_1 of 16 EPA PAHs in winter and summer period of 2009 [54].

Milutinović *et al.* [55] present a method for assessment of contribution to local PM levels of thermal power plant landfills. They combine concentration monitoring and Gaussian modelling to estimate ash resuspension and a dust cloud occurrence and location in real-time. This enables the landfill operator to take measures to reduce harmful effects downwind in the vicinity of the ash dump.

Table 1. Observed PM_{10} 24 h levels at automatic monitoring stations from national and local networks in Serbia in 2010 and 2011

Automatic station location		Annual average, μg/m^3		Number of 24 h limit value exceedance		Maximum, μg/m^3	
		2010	2011	2010	2011	2010	2011
Belgrade	Bulevar Despota Stefana	37	79	66	181	192	536
	Stari Grad	37	52	152	132	156	250
	Pančevački most	48		115	-	178	-
	Zeleno brdo	47	53	103	134	232	293
	Zemun	47		74	-	385	-
	Mostar	41	51	86	129	162	224
	New Belgrade 1	37	41	57	94	769	216
	New Belgrade 2	-	69	-	175	-	344
Belgrade Metropolitan	Lazarevac	53	-	115	-	226	-
	Obrenovac M. Milan 3	-	75	-	164	-	473
	Obrenovac Centar	-	69	-	186	-	278
Pancevo	Starčevo	60	-	149	-	252	
	Vojilovica	40	48	79	107	313	311
Smederevo	Radinac	60	85	161	258	269	355
	Ralja		69	-	208	–	251
Novi Sad	Dnevnik	36	45	62	102	113	147
Bor	Municipal Park	31	-	36	-	80	-
Niš		51	67	123	167	197	255
Kosjerić		-	63	-	159	-	270

Table 2. Overview of monitoring instruments, sampling periods and levels of PM_{10} and $PM_{2.5}$ observed at automatic stations or during campaigns in cities in Serbia; μ - average value ($\mu g/m^3$), σ - standard deviation

Sampling site(s)	Sampling period and duration	Sampling instrument and flow	Main results and remarks	Ref.
Belgrade, 3 sampling sites in city center	June-December 2002; 24 h data sets; 47 of PM_{10} and 49 of $PM_{2.5}$ samples	Mini-Vol LVS Airmetrics, Co. Inc. /5 lpm	PM_{10}: μ = 56 summer, μ = 96 winter $PM_{2.5}$: μ = 35 summer, μ = 75 winter	41
Belgrade, 2 sampling sites in city center	June 2003-July 2005, 209 PM_{10} and 64 $PM_{2.5}$	Mini-Vol LVS Airmetrics, Co. Inc. / 5 lpm	PM_{10}: μ = 68 (σ = 46.4); $PM_{2.5}$: μ = 61.4 (σ = 52.2)	42
Belgrade, 1 sampling site	November 2007-May 2008, PM_{10}, $PM_{2.5}$ and PM_1 4 seasonal campaigns each 20 days, 24 h data sets	LVS Leckel / 37.3 lpm	PM_{10} : μ = 96 autumn, μ = 89 winter, μ = 40 spring, μ = 40 summer $PM_{2.5}$: μ = 73 autumn, μ = 66 winter, μ = 22 spring, μ = 32 summer PM_1 : μ = 48 autumn, μ = 38 winter, μ = 14 spring, μ = 11 summer	43,44
Belgrade, 1 sampling site	November 2008-November 2009, PM_{10}, $PM_{2.5}$ and PM_1 4 seasonal campaigns each at least 20 days, 24 h data sets	LVS Leckel / 37.3 lpm	PM_{10} : μ = 23.1 summer, μ = 69.7 winter $PM_{2.5}$: μ = 12.8 summer, μ = 49.8 winter PM_1: μ = 8.8 summer, μ = 28 winter	45
Belgrade, 1 sampling site, city center	March-May 2010, PM_{10} and $PM_{2.5}$ 40 days, 24 h data sets	LVS Leckel / 37.3 lpm	Belgrade (traffic-residential) PM_{10}: μ = 44.84 $PM_{2.5}$: μ = 40.04	23
Novi Sad, AMS, state network	November 2009-July 2011, PM_{10} continuous monitoring	GRIMM	μ = 38.35, σ = 26.27 Rush hours: 7-10 h and 18-22 h slight increase, while slight decrease over weekend -heating period μ > 40, nonheating μ < 40	46
Zrenjanin, AMS, regional network	2005-2007, PM_{10} continuous monitoring	MP101 Teom	Daily average calculated for 676 days: μ = 33.76; nonheating period 417 samples μ = 27.95, exceedance 7.43%; heating 263 samples μ = 42.68 exceedance: 28.51%	47
Bor, Niš	September 2009-July 2010, PM_{10} and $PM_{2.5}$ 4 seasonal campaigns each 20 days in both towns, 24 h data sets	LVS Leckel / 37.3 lpm	Bor (residential-industrial): PM_{10}: μ = 34.1 summer, μ = 53.4 winter $PM_{2.5}$: μ = 22.8 summer, μ = 42.5 winter Niš (residential-traffic): PM_{10}: μ = 31.8 summer, μ = 57.7 winter $PM_{2.5}$: μ = 23.8 summer, μ = 42.5 winter	24,25
Pančevo, Vršac, Zrenjanin, Bor, Kikinda, 1 sampling site per city	Summer and autumn 2011, PM_{10} 6 days	LVS 24 h gravimetric data set and/or TSI-DRX Dust Track, continual data, 10 s resolution	Pančevo (urban): TSI: μ = 40.91 (σ = 3.02), LVS: μ = 40.40 (σ = 4.40) Vršac (urban): TSI: μ = 43.34 (σ = 6.07), LVS: μ = 47.04 (σ = 4.55) Zrenjanin (urban): TSI: μ = 43.75 (σ = 6.87) Bor-Krivelj (industrial): TSI: μ = 41.48 (σ = 7.46) Kikinda-Banatsko Novo Selo (rural): TSI: μ = 12.87 (σ = 2.17), LVS: μ = 13.61 (σ = 2.17)	48

Table 3 presents an overview of receptor studies using PM fractions collected in Serbia (Belgrade, Niš and Bor), analyzed for species including heavy metals, cations and anions and/or PAHs [42-44,49, 51,53,56-58].

PARTICULATE MATTER AND HUMAN HEALTH

Human health has been the main driver of European air quality legislation. Katsouyanni [59] and Jovanovic Andersen [60] summarize current findings on respectively, long-term and short-term effects of particulate matter on human health. Despite the large number of studies and the undisputable observed ef

Table 3. Overview of receptor modelling studies for PM in the Belgrade region (LVS - low volume sample; lpm - liter per minute; Dp - particle diameter; FAAS - flame atomic absorption spectrometry; AA - atomic absorption spectrometry; GFAAS - graphite furnace atomic absorption spectrometry; SEM/EDX - scanning electron microscopy/energy dispersive x-ray , OC/EC - organic/elemental carbon; HPLC - high performance liquid chromatography; HRMS-TOF - high-resolution mass spectrometer time of flight ; ICP-MS - inductively coupled plasma-mass spectrometer; IC -OES - inductively coupled plasma - optical emission spectrometer; PSCF - potential source contribution function; CWT - concentration weighted trajectory; N, NW, W, SW, S, SE, E, NE - geographic directions, PCA - principal component analysis; UNMIX - multivariate receptor model; PMF - positive matrix factorization)

Sampling site(s) location	Period of collecting and no. of samples	Sampling instrument(s)/sampling flow	Analyses	Main results and remarks	Ref.
Belgrade, 3 sampling sites in the city centre	June 2003 - – July 2005 50 24 h PM_{10} samples	Mini-Vol LVS Airmetrics, Co. Inc. sampling flow 5 lpm; Teflon and Quarz filters, $PM_{2.5}$, PM_{10}	Perkin Elmer FAAS, AA 200 and GFAAS AA 600: Pb, Cu, Zn, Mn, Fe, Cd, Ni, V, Al, Cr	UNMIX modelling-$PM_{2.5}$: fossil fuel 40%, metallurgical industry 13%, resuspended road dust 47%. PSCF and CWT: PM_{10} high probability for NW and W; V similarly distributed in NE, Al and Mn dominant from local sources, Mn transport from SE.	56,57
Belgrade, 3 sampling sites, city centre	July 2003 – December 2006, 277 24 h PM_{10} samples	Mini-Vol LVS Airmetrics, Co. Inc. sampling flow 5 lpm; Teflon and Quarz filters, PM_{10}	Perkin Elmer FAAS, AA 200 and GFAAS AA 600: Pb, Cu, Zn, Mn, Fe, Cd, Ni, V, Al, Cr	UNMIX modelling-PM_{10}: Fossil fuel 34%, regional transport mainly from steel and petrochemical industry 26%, resuspended road dust (19%) and traffic exhaust (21%). PSCF and CWT: PM_{10} high concentrations probability W-SW and S pathway.	50
Belgrade, 3 sampling sites, city centre	2004-2008, 24 h PM_{10} and $PM_{2.5}$ samples	Mini-Vol LVS Airmetrics, Co. Inc. sampling flow 5 lpm; Teflon and Quarz filters, $PM_{2.5}$, PM_{10}	Perkin Elmer FAAS, AA 200 and GFAAS AA 600: Pb, Cu, Zn, Mn, Fe, Cd, Ni, V, Al, Cr; SEM/EDX, JEOL 840A with INCAPentaFETx3	PSCF, CWT modelling: most frequently arriving directions W, NW, SW, during winter period N and SE; major contribution of PM_{10} from local and regional sources; $PM_{2.5}$ in heating period mean size value 1.32 μg (σ = 0.52), while 0.44 μg (σ = 0.27) in non-heating period	57
Belgrade, city centre, 1 sampling site	Jun-Dec 2008; 36 samples, every 6th day	HV Cascade Impactors, Model TE-236, collected particles size range; Dp < 0.49, 0.49< Dp < 0.95, 0.95 < Dp < 1.5, 1.5 < Dp < 3.0, 3.0 < Dp < 7.2 and Dp < 7.2 μm	IC system Metrohm, type 761 Compact IC, conductometric detector: Na, NH_4,K, Mg, Ca, Cl, NO_3, PO_4, SO_4	Mean mass concentration show maximums in 0.49 < Dp < 0.95 and Dp > 7.2 μg/m^3 range. The absolute highest concentration is SO_4^{2-} in the range 0.49 < Dp = 1.55 μg/m^3. Main sources for the generation of the particles were the gas precursors SO_2 and NH_3 over Belgrade urban area. PCA suggested the influence of marine aerosol	58
Belgrade, 1 sampling site	2007-2008 24 h about 40 PM_{10} samples in heating and 40 PM_{10} in non-heating period	LVS Leckel/37.3 lpm	ICP-OES: Al, Ba, Ca, Fe, K, Mg, Na, Ti, Zn ICP-MS:As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se,V; IC: NO_3^-, SO_4^{2-}, NH_4^+, K^+, Ca^{2+}, Na^+. TOT: OC/EC, HPLC and HRMS-TOF: biomass burning tracers	UNMIX modelling PM_{10}: winter: Biomass burning (52%), crustal/soil (36%), gasoline (5%), diesel (5%), secondary aerosols (2%) source; summer: soil/crustal (28%) and secondary aerosols (27%) dominant sources, diesel (14%) , gasoline (11%), wood burning (20%); diesel and gasoline contribution was higher during the summer (25%) than during the winter period (10%).	43,44,52
Belgrade, 2008-2009, 1 sampling site	2008-2009, 24 h about 40 samples per PM fraction and heating period, total samples	LVS Leckel/37.3 lpm	ICP-OES: Al, Ba, Ca, Fe, K, Mg, Na, Ti,Zn; ICP-MS:As, Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Sb, Se,V; IC:NO_3^-, SO_4^{2-}, NH_4^+, K^+, Ca^{2+}, Na^+.	PMF modelling metals, cations and $PM_{2.5}$: winter mixed coal-fired thermal power plant and fuel oil combustion in heating plants (29.9%); diesel and gasoline (27.7%); (secondary aerosol (23.1%); resuspended dust from road (10%); mixed resuspended salt from road and coal combustion from domestic heating (9.2%). Summer: PMF modelling PAH in PM_{10}: winter: coal and oil combustion 62.1% (~18 ng/m^3) diesel and gasoline 30.4% (~8.8 ng/m^3), wood burning 7.5% (~2.9 ng/m^3). Summer: coal and oil combustion 29.8% (~0.7 ng/m^3), diesel and gasoline 37.2% (~0.9 ng/m^3), 33.2% (~0.9 ng/m^3) wood burning.	45,53,54

fects, the mechanisms of action are not fully understood. Stankovic and Zivkovic [61] provide an overview of current knowledge on mechanisms of action of air pollution related to asthma, one of the most studied types of health end point.

Many studies point out that toxicological characteristics of locally collected PM fractions are necessary as a basis for locally valid health assessment. A study published in this issue [62], details an analysis of impact on human health of urban PM in the largest North Italian city Milan. Molecular markers of exposure were used as characteristics of effects of summer and winter PM_{10} and $PM_{2.5}$. Results of in vitro and in vivo testing show the need for a comprehensive knowledge of PM composition and sources in a given region. For Milan, it was shown that the most cytotoxic and pro-inflammatory fraction in summer was PM_{10} enriched in crustal elements and endotoxins. In winter, the fine fraction $PM_{2.5}$ induced a stronger effect than PM_{10}: genotoxic effects and xenobiotic metabolizing enzymes (like CYP1B1) production increased as a consequence of the higher content of combustion derived particles rich in PAHs and heavy toxic metals.

Several epidemiological results are already available from Serbia for the last decade. For the first time in Serbia, short-term effects of air pollution on cardiovascular hospitalization were quantified on an elderly population in the Niš region [63]. Although the authors report increased risk of total hospitalizations, their results did not support findings from previous studies that showed an increase in number of cardiovascular hospitalizations in elderly in association with increase of 10 $\mu m/m^3$ of black smoke measured using a refractometry method.

Environmental tobacco smoke (ETS), a source of numerous gaseous and particulate pollutants in indoor environment, poses a recognized health concern. An epidemiological study was done on 708 children aged 11-14 years from the city of Niš [64]. Smoking in the home was associated with an increased respiratory symptoms (dyspnea, wheezing), bronchitis and asthma.

PARTICIPATORY GOVERNANCE AS PART OF MITIGATION SOLUTIONS

Development and implementation of research based mitigation measures requires a wide societal dialogue, where the decision makers, the scientists and a variety of other societal actors are partners. According to Kingdon [65], for a policy to be formulated, a collusion of three factors is to be in place: the research has to recognize a problem and offer its solutions, the means necessary for the solution are to be available, and there is to be a wider political consensus.

The process can be seen as consisting of three stages: consensus within science, consensus between science and decision-makers, and consensus between the three actors - science, decision-makers and society. Recent examples can give some insight.

It is argued that to create a valid science, a dialogue between science and society is necessary. In atmospheric research, the ACCENT Network of Excellence [66] recognized the need to include a societal dialogue in knowledge productions, and argues that the research community is ready to do so [67]: “The dialogue between scientists and stakeholders should not be limited to the dissemination of results, but should involve stakeholders already from the early stages of problem identification” [68].

The issues of how to bring science nearer to decision-making have been studied by many. Recently, the HENVINET network [5,7] investigated how to create a network of all stakeholders to support environmental health decisions, and concluded that the mutual understanding of and respect for different perspectives is essential. This indicates that a participatory process of informing decision makers by science and scientists by the decision making is needed.

Several policy developments, most notably the UN CLRTAP [69], provide examples of successful implementation of research based legislative processes. Davidson and Nordbeck [70] give a historical overview of the development and implementation of the Clean Air Act in the USA, The appendix to this book offers an overview of actions of the Environmental Protection Agencies of individual States. Also, owing to the fact of the special autonomity status of Californian environmental legislation, the most comprehensive actions were taken by the Californian Air Resources Board (CARB). CARB employed a wide variety of approaches to develop and implement air quality legislation, in collaboration with stakeholders including the industries, the civil society groups, and researchers.

A successful example of a local air quality management program, “STOP PRACH” or “Stop Dust” is briefly described by *Kotlik et al.* [71,72]. Open pit mining is a very controversial issue, as it affects large districts in a number of ways, and alters forever the local living conditions. In the neighbouring communities of a major open pit mine ”Lom Bilina” in North Bohemia, CZ, levels of dust were perceived as extremely high, especially in episodes with atmospheric conditions favourable to dispersion of dust. In response to the public demand, an initiative STOP PRACH

(Stop Dust) was formed as collaboration between the mine owner, the most affected municipalities, local NGOs and the Ministry of Environment. National bodies responsible for air quality monitoring and assessments and public health protection contributed with research. The public was also invited as a partner in the process.

An assessment of the air quality situation and contribution of the main sources to PM_{10} levels was a first step. The proposed goals of "Stop Dust" and simple municipal-level plans were accepted through a series of conferences, meetings, public consultations and negotiations with all local stakeholders, and recommended for implementation by the elected representatives.

The following factors are considered essential for achieving success [71]:

- A functioning partnership among all of the stakeholders.
- A "critical mass" of energy (interest, determination, time) from key interest groups.
- The existence of a true will to implement the proposed measures by the primary "movers", the owners of the open pit mine.
- Government support.

The "Stop Dust" activity put an emphasis on providing credible scientific information to the affected parties, and on impartial managing of the discussion. "Stop Dust" produced a minimum of documents, and its support materials were very brief. It was primarily a communication, negotiation and decision-making process. This has contributed to a wide acceptance of the proposed solutions by all stakeholders.

CURRENT TRENDS AND FINAL REMARKS

The WeBIOPATR conference highlighted several issues to be addressed in the near future. First, it is the need to close a number of knowledge gaps in atmospheric sciences, atmospheric modelling and environmental health and social sciences. National data needs to be generated to allow monitoring of trends and of effectiveness of the implemented measures. This information needs to feed into a participatory process of decision making.

In addition, there are several exciting technological and scientific opportunities that may change the research methodologies as well as practice of the air quality management. New monitoring technologies respond to the needs of the environmental health research and allow, *e.g.*, for monitoring of oxidative capacity of combustion particles [73]. New monitoring approaches, including community based monitoring using ubiquitous sensing [74], offer a tool for involving the public as well as to provide environmentally relevant information that can supplement existing monitoring and other information gathering systems. New activities in this direction are already being developed.

Issues of particulate matter pollution are rather pressing. The conference has further documented that without a broad cross-sectoral and societal alliances, they cannot be solved. It has contributed to common understanding of these issues, and enabled an improvement of tools, methods and measures suitable for use in air quality mitigation in Serbia.

Acknowledgements

The 3rd WeBIOPATR workshop and conference was supported by grants from the Ministry of Education and Science of Republic of Serbia, the Norwegian Institute for Air Research, Institute Vinča and Public Health Institute of Belgrade.

REFERENCES

[1] M. Jovasevic-Stojanovic, A. Bartonova, Chem. Ind. Chem. Eng. Q. **16** (2010) 207-212

[2] M. Jovasevic-Stojanovic, A. Bartonova, Eds., Book of Extended Abstracts, The First International WeBIOPATR Workshop, Particulate Matter: Research and Management, Belgrade, Serbia, 2007, pp. 1-135

[3] A. Bartonova, M. Jovasevic-Stojanovic, Eds., Proceedings from the 2nd Workshop, Particulate Matter: Research and Management, Mokra Gora, Serbia, 2009, pp. 1-153

[4] A. Bartonova, M. Jovasevic-Stojanovic, Eds., Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, Belgrade, Serbia, 2011, pp. 1-63

[5] A. Bartonova, J.G. Koppe, A. Fucic, A.C. Gutleb, P.van den Hazel, H. Keune, Environmental Health **11**, Suppl 1, (2012) S1

[6] B. Sivertsen, A. Bartonova, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 667-674

[7] H. Keune, A.C. Gutleb, K. E. Zimmer, S. Ravnum, A. Yang, A. Bartonova, M. K. von Krauss, E. Ropstad, G.S. Eriksen, M. Saunders, B. Magnanti, B. Forsberg, Environ. Health **11** Suppl 1 (2012) S3

[8] H.-Y. Liu, A. Bartonova, M. Pascal, R. Smolders, E. Skjetne, M. Dusinska, Environ. Health **11** (2012) 88

[9] J. Alcamo, R. Shaw, L. Hordijk, Eds., The RAINS Model of Acidification. Science and Strategies in Europe, Kluver Academic Publishers, Dordrecht, 1990

[10] ExternE project-External Costs of Energy, http:// //www.externe.info/externe_d7/ (accessed 10 October 2012)

[11] European Environment Agency, Environmental indicators: typology and overview, Copenhagen, 1999

[12] D.J. Briggs, Environ.Health **7** (2008) 1-17

[13] E. Lebret, F. Hurley and D. Briggs, Epidemiology **19**(6) (2008) S66; see also www.heimtsa.eu (accessed 23 November 2012)

[14] A. Yang, M. Loh, A. Kuhn, A. Bartonova, L.E. Gerharz, Epidemiology **22**, suppl (2011) S213-S213

[15] L.E. Gerharz, M. Loh, A. Yang and A. Kuhn, University of Lueneburg Paper, 2009, http://ffb.uni-lueneburg.de//iatur2009/downoads/paper_presentation/Wednesday/P_S_1/Gerharz_Loh_Yang_Kuhn___Using%20European%20Time%20Use%20Data%20for%20Modelling%20Individual%20Exposure%20to%20Air%20Pollution%20%28Paper%29.pdf (accessed 23 November 2012)

[16] Harmonised European Time Use Study-HETUS, https:////www.testh2.scb.se/tus/tus/ (accessed 10 October 2012)

[17] Centre for Time Use Research, The Multinational Time use Study-MTUS, http://www.timeuse.org/mtus/ (accessed 10 October 2012)

[18] Joint Research Center, Institute for Health and Consumer Protection, The European Exposure Factors Sourcebook-ExpoFacts, http://expofacts.jrc.ec.europa.eu/ (accessed 10 October 2012)

[19] ENVIE Co-ordination Action on Indoor Air Quality and Health Effects, http://paginas.fe.up.pt/~envie//what_is_it.html, (accessed 6 August 2012)

[20] S. Tirendi, O. Geiss, P. Leva, J. Barrero-Moreno, D. Kotzias, in Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 42

[21] E. de Oliveira Fernandes, M. Jantunen, P. Carrer, O. Seppänen, P. Harrison, S. Kephalopoulos, ENVIE Co-ordination Action on Indoor Air Quality and Health Effects. Publishable final report, 2009, http://paginas.fe.up.pt/~envie/documents/finalreports/Final%20Reports%20Publishable/Publishable%20final%20activity%20report.pdf (accessed 6 August 2012)

[22] Schools Indoor Pollution and Health - SINPHONIE project, www.sinphonie.eu (accessed 6 August 2012)

[23] M. Jovasevic-Stojanovic, A. Cvetkovic, S. Tošovic, S. Matic-Besarabic, L. Adjanski, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 47

[24] R. Kovacevic, V. Tasic, M. Jovasevic-Stojanovic, N. Milosevic, N. Petrovic, J.N. Petrovic, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 29

[25] V. Tasić, R. Kovačević, M. Jovašević-Stojanović, N. Živković, A. Đorđević, N. Milošević, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management,: A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 31

[26] European Monitoring and Assessment Program-EMEP, www.emep.int (accessed 6 August 2012)

[27] S. Tsyro, K.E. Yttri, W. Aas, Measurement and model assessment of particulate matter in Europe, In: Transboundary Particulate Matter in Europe, EMEP Status Report 4/2011, Norwegian Institute for Air Reseach, Kjeller, Norway, 2011

[28] K. Tørseth, W. Aas, K. Breivik, A.M. Fjæraa, M. Fiebig, A.G. Hjellbrekke, C. Lund Myhre, S. Solberg, K.E. Yttri, Atmos. Chem. Phys. **12** (2012) 5447-5481

[29] S. Tsyro, D. Simpson, G. Fagerli, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 18

[30] EC, Directive 2008/50/EC, Official Journal of EU, L152, 2008, pp. 1-42

[31] The European Air Quality Data Base - AirBase http:////www.eea.europa.eu/data-and-maps/data/airbase-the-european-air-quality-database-6 (accessed 10 October 2012)

[32] J.P. Putaud, R. Van Dingenen, A. Alastuey, H. Bauer, W. Birmili, J. Cyrys, H. Flentje, S. Fuzzi, R. Gehrig, H.C. Hansson, R.M. Harrison, H. Herrmann, R. Hitzenberger, C. Huglin, A.M. Jones, A. Kasper-Giebl, G. Kiss, A, Kousa, T.A. Kuhlbusch, G. Loschau, W. Maenhaut, A. Molnar, T. Moreno, J. Pekkanen, C. Perrino, M. Pitz, H. Puxbaum, X. Querol, S. Rodriguez, I. Salma, J. Schwarz, J. Smolik, J. Schneider, G. Spindler, H. ten Brink, J. Tursic, M. Viana, A. Wiedensohler, F. Raes, Atmos. Environ. **44** (2010) 1308-1320

[33] EEA Technical report, No 1/2009, Spatial Assessment of PM_{10} and ozone in Europe, 2005, Copenhagen, Denmark 2009

[34] M. Lutz, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 12

[35] J. Fiala, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 25

[36] Serbian Environmental Protection Agency-SEPA, http:////www.sepa.gov.rs/ams/xajax_data/eas_kvalitet_vazduha_1.php (accessed 10 October 2012)

[37] Province of Vojvodina Secretary of Urbanism, Construction and Environmental Protection www.eko.vojvodina.gov.rs/?q=node/271 (accessed 10 October 2012)

[38] Municipal Public Health Institute of Belgrade, www.beoeko.com (accessed 10 October 2012)

[39] Serbian Environmental Protection Agency-SEPA, Annual Report on the Air Quality in the Republic of Serbia for 2010, Belgrade, Serbia, 2011, p. 22

[40] Serbian Environmental Protection Agency-SEPA, Annual Report of the Air Quality in the Republic of Serbia for 2011, Belgrade, Serbia, 2012, p. 23

[41] S. Rajsic, M. Tasic, V. Novakovic, M. Tomasevic, Environ Sci&Pollut Res **11** (2004) 158-164

[42] S. Rajsic, Z. Mijic, M. Tasic, M. Radenkovic, J. Joksic, Environ. Chem. Lett. **6** (2008) 95-100

[43] J. Joksić, M. Radenković, A. Cvetković S. Matić-Besarabić, M. Jovašević-Stojanović, A. Bartonova, K.E. Yttri, Chem. Ind. Chem. Eng. Q. **16** (2010) 251-258

[44] J. Joksić, PhD. Thesis, Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia, 2009, pp. 1-80

[45] A. Cvetković, Ph.D. Thesis, Faculty of Applied Ecology “Futura”, Singidunum University, Belgrade, Serbia, 2010, pp. 1-137

[46] B. Simendić, N.Jović, Monitoring Expert. Safety Eng. **2** (2012) 8-17

[47] B.B. Vujić, D.B. Milovanović, D.M. Ubavin, Hem. Ind. **64** (2010) 453-458

[48] Sustainable development for Banat region by means of education and scientific research & development in transboundary air quality monitoring issues-BANATAIR, http://banatair.mec.upt.ro/campaigns.html (accessed 10 October 2012)

[49] V. Tasic, N. Miloševic, R. Kovačevic, M. Jovasevic-Stojanovic, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 643-652

[50] Z. Mijic, A. Stojic, M. Perisic, S. Rajsic, M. Tasic, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 623-634

[51] Z. Mijic, M. Tasic, S. Rajsic, M. Kuzmanovski, A. Stojic, A. Zekic, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management,: A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 51

[52] J. Joksic, M. Karl, K.E. Yttri, M. Jovasevic-Stojanovic, A. Bartonova, M. Radenkovic, A. Cvetkovic, Proceedings from the 2nd Workshop, Particulate Matter: Research and Management,: A. Bartonova, M. Jovasevic-Stojanovic, Eds., Mokra Gora, Serbia, 2009, pp. 14-19

[53] A. Cvetkovic, M. Jovasević-Stojanovic, A. Bartonova, D. Marković, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 26

[54] A. Cvetković, M. Jovašević-Stojanović, Lj. Adjanski-Spasic, S. Matic-Besarabic, D. Marković, Chem. Ind. Chem. Eng. Q. **16** (2010) 259−268

[55] P. Milutinovic, Z. Grsic, N. Zivkovic, D. Dramlic, Z. Velikic, S. Dramlic, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 681--692

[56] Z. Mijić, S. Rajšić, A. Žekić, M. Perišić, A. Stojić, M. Tasić, in: Air Quality, A. Kumar, Ed., Scyio Publisher, Croatia, 2010, pp. 143-167

[57] Z. Mijic, A. Stojic, M. Perisic, S. Rajsic, in: Air Quality-New Perspective, eds: G.L. Badilla, B. Valdez, M. Schorr, Scyio Publisher, Croatia, 2012, pp. 199-224

[58] D. Djordjevic, A. Mihajlidi-Zelic, D. Relic, Lj. Ignjatovic, J. Huremovic, A.M. Stortini , A. Gambaro, Atmos. Environ. **46** (2012) 309-317

[59] K. Katsouyanni, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 675-679

[60] Z. Jovanovic Andersen, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 617-622

[61] A. Stankovic, M. Zivkovic, T. Djuric, D. Alavantic, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p 15

[62] P. Mantecca, M. Gualtieri, E. Longhin, G. Bestetti, P. Palestini, E. Bolzacchini, M. Camatini, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 635-641

[63] A. Stankovic, M. Nikolic, D. Bogdanovic, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 661-665

[64] M. Nikolic, A. Stankovic, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 57

[65] K.J. Kingdon, Agendas, alternatives and public policies, Harper Collins, New York, 1984

[66] P. Grennfelt, L. Linday, R. Maas, G. Sundquist, R. Lindskog, F. Raes, J. Arnell, IVL Report B1671, IVL Gøteborg, Sweden, 2006

[67] A. Guimaraes Pereira, F. Raes, T. De Sousa Pedrosa, P. Rosa, S. Brodersen, M. Søgaard Jørgensen, Atmos. Environ. **43** (2009) 5423-5432

[68] S. Fuzzi, M. Maione, ACCENT-Atmospheric Composition Change: the European Network (2004-2009), Final Report, 2009, http://www.accent-network.org/accent_documents/FINAL%20Booklet.pdf (accessed 23 November 2012)

[69] J. Sliggers, in: Environment, Health - A Global Management Perspective, Ch. 10, Convention on Long-Range Transboundary Air Pollution, P. Wexler, J. van der Kolk, A. Mohapatra, R. Agarwal, Eds., 2011, pp. 155-169

[70] J. Davidson and J.M. Nordbeck, An Interactive History of the Clean Air Act: Scientific and Policy Perspectives, Elsevier, Amsterdam, 2012

[71] B. Kotlík, L. Paroha, P. Borůvková, O. Vonková, J. Morávek, H. Kazmarová, J. Keder, Abstracts from Keynote Invited Lectures and Contributed Papers, The Third International Workshop and Conference, Particulate Matter: Research and Management, A. Bartonova, M. Jovasevic-Stojanovic, Eds., Belgrade, Serbia, 2011, p. 26

[72] http://www.stop-prach.cz (accessed 23 November 2012)

[73] S. Stevanovic, Z.D. Ristovski, B. Miljevic, K.E. Fairfull-Smith, S. E. Bottle, Chem. Ind. Chem. Eng. Q. **18**(4) (2012) 653-659

[74] A. de Nazelle, E. Seto, Donaire, D. Rodriguez, M. Nieuwenhuijsen, M. Jerrett, Abstract S-0035 in Abstracts of the 23rd Annual Conference of the International Society of Environmental Epidemiology (ISEE), 2011, Barcelona, Spain, available at: http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.isee2011 (accessed 4 September 2012).

ALENA BARTOŇOVÁ[1]
MILENA JOVAŠEVIĆ-STOJANOVIĆ[2]

[1]NILU Norwegian Institute for Air Research, Kjeller, Norway
[2]Institut za nuklearne nauke Vinča, Univerzitet u Beogradu, Beograd, Srbija

PREGLEDNI RAD

INTEGRALNA PROCENA I UPRAVLJANJE RESPIRABILNIM ČESTICAMA U AMBIJENTNOJ SREDINI - INTERNACIONLANA PERSPEKTIVA I TEKUĆA ISTRAŽIVANJA U SRBIJI

U skladu sa strogim kriterijumima o nivou aerozagađenja u ambjentnoj sredini, neophodno je da se smanji aerozagađenje i u Srbiji. Za uspešnu implementaciju mera za smanjenje aerozagađenja potrebno je da se raspolaže sa dovoljno podataka na osnovu domaćih istraživanja i da se uspostaviti efikasan proces učešća javnosti na lokalnom nivou. U cilju podrške procesu smanjenja aerozagađenja u regionu Zapadnog Balkana, tokom realizacije WeBIOPATR projekta započeta je serija konferencija koje se počev od 2007. održavaju svake druge godine. One povezuju interdisciplinarnu istraživačku zajednicu sa lokalnim i državnim vlastima Srbije i susednih zemalja, da bi se predstavili rezultati istraživanja u Srbiji i zemljama širom sveta i da be se razmenila znanja i najbolje prakse za smanjenje aerozagađenja. Konferencije promovišu integralnu procenu respirabilnih četica i bliže „Pritisak-Stanje-Uticaj" (PSI) u okviru "Pokretač-Pritisak-Stanje-Uticaj-Odgovor" (DPSIR) koncepta. Integralni pristup treba da se oslanja na istraživanja u okviru disciplina kao što su: tehnologije monitoringa aerozagađenja, sastav atmosfere uključujući i ambijentu sredinu, modelovanje atmosfere, biološki efekti i zdravlje ljudi. Na konferencijama su prikazane najnovije studije o respirabilnim česticama koje su sprovodene u Srbiji i inostranstvu. U interakciji između predavača i auditorijuma, izgrađuje se široka interdisciplinarna i višesektorska ekspertiza za podršku primene rezultata istraživanja u praksi. Takođe je omogućeno da se prezentuju primeri uspešnih akcija smanjenja aerozagađenja koji su ostvareni uz pomoć učešća lokalne uprave za zaštitu životne sredine, što ukazuje na rastuće potrebe da se uključi i javni i privatni sektor. Ovaj rad daje osnovne karakteristike celovitog lančanog pristupa i elemente intergaralnog pristupa istraživanja respirabilnih, čestica, sumira naučne radove prikazane na 3. WeBIOPATR konferenciji, a pored toga daje i pregled rezultata monitoringa i identifikacije izvora respirabilnih čestica u Srbiji od početka merenja respirabilnih čestica u ambijentnom vazduhu u poslednjih deset godina.

Ključne reči: respirabilne čestice, integralna procena, izvor, ekspozicija, zdravstveni efekti.