



WeBIOPATR 2021

The Eighth International WEBIOPATR
Workshop & Conference
Particulate Matter: Research and Management

Abstracts of Keynote Invited Lectures and Contributed Papers

Milena Jovašević-Stojanović,

Alena Bartoňová,

Miloš Davidović and Simon Smith, Eds

Vinča Institute of Nuclear Sciences

Vinča, Belgrade 2021

**ABSTRACTS OF KEYNOTE INVITED LECTURES AND
CONTRIBUTED PAPERS**

The Eighth WeBIOPATR Workshop & Conference
Particulate Matter: Research and Management

WeBIOPATR 2021

29th November to 1st December 2021

Vinča, Belgrade, Serbia

Editors

Milena Jovašević-Stojanović

Alena Bartoňová

Miloš Davidović

Simon Smith

Publisher

Vinča Institute of Nuclear Sciences

Prof. Dr Snežana Pajović, Director

P.O.Box 522

11001 Belgrade, Serbia

Printed by

Vinča Institute of Nuclear Sciences

Number of copies

150

ISBN 978-86-7306-164-1

© Vinča Institute of Nuclear Sciences

Vinča, Belgrade 2021.

www.vin.bg.ac.rs/

SCIENTIFIC COMMITTEE

Aleksandar Jovović, Serbia
Alena Bartoňová, Norway
Antonije Onjia, Serbia
David Broday, Israel
Dikaia Saraga, Greece
Griša Močnik, Slovenia
Ivan Gržetić, Serbia
María Cruz Minguillón, Spain
Milena Jovašević-Stojanović, Serbia
Miloš Davidović, Serbia
Saverio de Vito, Italy
Selahattin Incecik, Turkey
Slobodan Ničković, Serbia
Simone Barreira Morais, Portugal
Zoran Mijić, Serbia
Zoran Ristovski, Australia
Zorana Jovanović-Andersen, Denmark

ORGANIZING COMMITTEE

Aleksandra Stanković, Serbia
Alena Bartoňová, Norway
Andrej Šoštarić, Serbia
Anka Cvetković, Serbia
Biljana Filipović, Serbia
Branislava Matić, Serbia
Lidija Marić-Tanasković, Serbia
Uzahir Ramadani, Serbia
Ivan Lazović, Serbia
Sonja Dmitrašinić (Secretary), Serbia
Marija Živković (Secretary), Serbia
Milena Jovašević-Stojanović, Serbia
Miloš Davidović, Serbia
Mira Aničić Urošević, Serbia
Mirjana Perišić, Serbia
Nenad Živković, Serbia
Tihomir Popović, Serbia
Vesna Slepčević, Serbia
Viša Tasić, Serbia

CONFERENCE TOPICS

1. Atmospheric Particulate Matter - Physical and Chemical Properties

- i. Sources and formation of particulate matter
- ii. Particulate matter composition and levels outdoors and indoors
- iii. Environmental modeling
- iv. Nanoparticles in the environment

2. Particulate Matter and Health

- i. Exposure to particulate matter
- ii. Health aspects of atmospheric particulate matter
- iii. Full chain approach
- iv. COVID-19 and particulate matter

3. Particulate Matter and Regulatory Issues

- i. Issues related to monitoring of particulate matter
- ii. Legislative aspects
- iii. Abatement strategies

Organizers



Vinča Institute of Nuclear Sciences, University of Belgrade, National Institute of the Republic of Serbia, Serbia

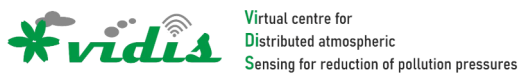
Public Health Institute of Belgrade, Serbia

NILU Norwegian Institute for Air Research, Norway

The 8th WeBIOPATR Workshop and Conference,

Particulate Matter: Research and Management, WEBIOPATR2021

is supported by:



*EC H2020 Framework Program for Research and Innovation,
area “Spreading excellence and widening participation”,
VIDIS project (2020-2023) coordinated by Vinča Institute of Nuclear Sciences,
Grant agreement number 952433.*



Ministry of Education, Science and Technological Development of the Republic of Serbia

PREFACE

Dear Colleagues,

Welcome to the 8th WeBIOPATR Conference, to be held at the premises of the Vinca Institute of Nuclear Sciences, Serbia, 29.11.–1.12.2021, as a combination of online and face-to-face event.

The International Workshop and Conference, Particulate Matter: Research and Management – WeBIOPATR is a biennial event held in Serbia since 2007. The conference addresses air quality in general and particulate matter specifically. Atmospheric particulate matter arises both from primary emissions and from secondary formation in the atmosphere. It is one of the least well understood local and regional air pollutants, has complex implications for climate change, and is perhaps the pollutant with the highest health relevance. It also poses many challenges to monitoring.

By WeBIOPATR, we aim to link the research communities with relevance to particulate matter with the practitioners of air quality management on all administrative levels, in order to facilitate professional dialogue and uptake of newest research into practice. The workshops usually draw an audience of about 70 and attract media attention in Serbia. It enjoys support of the responsible authorities, Ministry of Education, Science and Technological Development, Ministry of Health, Ministry of Environment, and the Serbian Environmental Agency whose sponsorship is indispensable and gratefully acknowledged. We also enjoy support of international bodies such as the WHO.

The 1st WeBIOPATR Workshop was held in Beograd, 20.-22. May 2007, associated with a project funded by the Research Council of Norway. The 2nd workshop was held in Mećavnik, Serbia, 28.8.-1.9.2009. WeBIOPATR2011 was held in Beograd 14.-17.11.2011 and for the first time, included a dedicated student workshop. WeBIOPATR2013 was held in Beograd 2.-4.10. 2013. It covered the traditional PM research and management issues, discussions on how to encourage citizens to contribute to environmental governance, and how to develop participatory sensing methods. WeBIOPATR2015 was held in Beograd 14.-16.10. 2015. Dedicated sessions were devoted to sensor technologies for air quality monitoring, utilizing information and input from the EU FP7 funded project CITI-SENSE (<http://co.citi-sense.eu>) and the EU COST action EuNetAir (www.eunetair.it). WeBIOPATR2017, the 6th conference, was held in Beograd 6.-8.9. 2017, with a wider than before Western Balkan participation. The 7th WeBIOPATR2019 was held 1.-4.10. 2019 at the Mechanical Faculty, University of Belgrade. It has attracted a record of over 50 contributions, and brought together scientists from 12 countries, documenting that the issues of atmospheric pollution, with their wide implications for climate change, human health and ecosystem services, are no less important today. This year's event will be with similar number of contributions that have been accepted.

In the past two years, all our lives were affected by the COVID-19 pandemic. We have adapted our ways of life and work – and now we hope that the new format of the conference

will be a success, for the participants physically present as well as for those who will participate online.

We are very grateful to our unrelenting national and international partners for their financial and scientific support for this event. In addition, WeBIOPATR2021 is supported by the VIDIS project, <https://vidis-project.org/>, funded by the EC H2020 Framework Programme for Research and Innovation, area “Spreading excellence and widening participation”. VIDIS (2020-2023) is coordinated by Vinca Institute, Grant agreement number 952433.

Welcome to Vinca and online and have a stimulating and productive time!

Milena Jovašević-Stojanović and Alena Bartoňová

TABLE OF CONTENTS

1.	INDOOR, VENTILATION, PROTECTION.....	11
1.1	COVID-19, Particles in the Air and Ventilation	12
1.2	Applying Aerosol Science to the Current Needs: Particle Removal Efficiency of Face Masks During the COVID-19 Pandemic	13
1.3	Personal Protection Against Airborne Particulate Matter	14
1.4	The Role of Microclimate in the Formation of Indoor Air Pollution.....	15
2.	LOW-COST SENORS	17
2.1	PM Low-Cost Sensors Calibration in the Wild: Methods and Insights From AirHeritage Project	18
2.2	Schools for Better Air Quality: Citizens-Based Monitoring, Stem Education, and Youth Activism in Serbia <i>UNICEF in Serbia</i>	19
2.3	Assessing Air Pollution from Wood Burning Using Low-Cost Sensors and Citizen Science20	
2.4	Potential for Using Low-Cost Sensor Measurements in Outdoor Environmental Quality Particulate Matter Measurements.....	21
3.	SCIENCE – POLICY	23
3.1	How Do We Understand Interdisciplinarity in Environment and Climate Research: Results From a Recent Study in Norway	24
3.2	The Hybrid Computational Approach in Revealing Particulate Matter Related Processes ...	25
4.	HEALTH AND EXPOSURE I	27
4.1	Long-term Exposure to Air Pollution and Mortality: Overview with Focus on the Low-exposure Areas	28
4.2	Air Pollution and the Growth of Children – Is There a Connection?.....	29
4.3	Health Risk Assessment of Particulate Matter Emissions from Natural Gas and Fuel Oil Heating Plants Using Dispersion Modelling	30
4.4	Assessment of Increased Individual-Level Exposure to Airborne Particulate Matter During Periods of Atmospheric Thermal Inversion	31
4.5	How Will the New Who Air Quality Guidelines for PM _{2.5} Affect the Health Risk Assessment by the European Environment Agency.....	32
5.	HEALTH AND EXPOSURE II.....	33
5.1	Biomarkers of Exposure to Particulate Matter Air Pollutants: A Precious Tool for Studying Health-Related Effects	34
5.2	Experimental Approaches for Studying Viral infectivity, RNA Presence and Stability in Environmental PM: Dedicated Sampling, Biosensors, and Adaptation of Standard TECHNIQUES.....	35
5.3	Exposure to Particulate Matter in Fire Stations: Preliminary Results	36
5.4	A Numerical Model for Pollen Prediction: Thunderstorm Asthma Case Study	37
6.	PM MONITORING AND MODELLING I.....	39
6.1	Introduction to Transboundary Particulate Matter in Europe.....	40

6.2 SAMIRA-Satellite Based Monitoring Initiative for Regional Air Quality – Lessons Learned and Plans	41
6.3 Chemical Composition of PM particles Inside the Laboratory and in the Ambient Air Near the Copper Smelter in Bor, Serbia	42
6.4 Planning and Conducting Mobile Aerosol Monitoring Campaign: Experiences from Belgrade and Novi Sad	43
6.5 Assessment of Detected In Situ and Modelled PM Concentration Levels During Urban Transformation Processes in Novi Sad, Serbia	44
7. PM MONITORING AND MODELLING II	45
7.1 Accounting for Spatiotemporal Information Improves the Imputation of Missing PM _{2.5} Monitoring Records	46
7.2 A Method for Tracing the Sources of AirBorne Dust Using Source-Simulation and Multivariate PLS Modelling of Chemical Analytical Data	47
7.3 Seasonal Variation in Ambient PM ₁₀ Concentrations Over the Novi Sad Agglomeration.....	48
7.4 An Overview of Monitoring and Research of Atmospheric Particulate Matter in Serbia in the Past Half Decade	49
8. OXIDATIVE STRESS.....	51
8.1 Real-time Reactive Oxygen Species Measurements in Chinese Cities.....	52
8.2 Source Apportionment of Oxidative Potential – What We Know So Far.....	53
8.3 A Study on Tropospheric Aerosols Change During the COVID-19 Lock-down Period: Experience From EARLINET Measurement Campaign.....	54
8.4 Comparative Statistical Analysis of Particulate Matter Pollution and Traffic Intensity on a Selected Location in the City of Novi Sad.....	55
9. AEROSOL CHARACTERIZATION I.....	57
9.1 Measuring Aerosol Absorption – The Advantage of Direct Over Other Methods, and Multi-Wavelength Calibration.....	58
9.2 Apportionment of Primary and Secondary Carbonaceous Aerosols Using an Advanced Total Carbon – Black Carbon (TC-BC _{7-λ}) Method.....	59
9.3 Variation of Black Carbon Concentration in Cold and Warm Seasons in Skopje Urban Area	60
10. AEROSOL CHARACTERIZATION II	61
10.1 Secondary Organic Aerosol Formation From Direct Photolysis and OH Radical Reaction of Nitroaromatics.....	62
10.2 Emerging Pollutants in Atmospheric Aerosols in Latvia: Present Situation Overview	63
10.3 Chemical Composition and Source Apportionment of PM _{2.5} at a Suburban Site in the Northwestern Part of Turkey.....	64
10.4 Key Factors Governing Particulate Matter Environmental Fate in an Urban Environment	65
10.5 Harmonization of UFP Measurements: A Novel Solution for Microphysical Characterization of Aerosols.....	66
11. POSTER SESSION.....	67
11.1 Effects of Biomass Fuel Smoke on Maternal Health and Pregnancy Outcomes.....	68

11.2 Effect of Substitution of Old Coal Boilers with New Biomass Boilers on the Concentration of Particulate Matter in Ambient Air: A Case Study Mionica	69
11.3 Civic Air Quality Monitoring as an Alternative and Supplement to the State Air Quality Monitoring Network.....	70
11.4 PM Emissions from Newly-Built Wood Chip Combustion Plants: Case Study for Serbia .	71
11.5 Air Pollution and Traffic Accidents – Is There a Connection?	72
11.6 Assessment of the Burden of Disease due to PM _{2.5} Air Pollution for the Belgrade District	73
11.7 Modeling Controlled Aerosol Atmosphere by Utilizing Physics Based Modeling: Experience from using Computational Fluid Dynamics Approach	74
11.8 Portable Air Quality Monitor Based on Low-cost Sensors	75
11.9 Determination of Levoglucosane and its Isomers in Ambient Air PM Using Gas Chromatography with Mass Selective Detector in the Belgrade Urban Area	76
11.10 Comparison of Low-cost PM sensors in an Indoor Environment	77
11.11 Evaluation of Gaseous Emission Characteristics During Forest Fuel Combustion in Mass Loss Calorimeter Coupled with FTIR Apparatus.....	78
11.12 Lock-down Influence on Air Quality in Belgrade During COVID–19 Pandemic	79
11.13 Engagement of Public Health Institutions in Monitoring of Heavy Metals’ Presence in PM ₁₀ in the Vicinity of Industrially Contaminated Sites in Serbia	80
11.14 Characterisation of Fine Particulate Matter Level, Content and Sources of a Kindergarden Microenvironment in Belgrade City Center.....	81
11.15 Numerical Simulation of Gas Flow Through Perforated Plates Inclined to the Main Flow	82
11.16 PM Low-Cost Sensors in-Field Calibration: The Influence of Sampling Coverage and Intervals.....	83
11.17 Preliminary Results from PM Mobile Monitoring Pilot Campaign in Boka Kotorska Bay: PM Levels and Observed Modes in Onshore and Offshore Area	84
AUTHOR INDEX.....	85

9.3 VARIATION OF BLACK CARBON CONCENTRATION IN COLD AND WARM SEASONS IN SKOPJE URBAN AREA

D. Mirakovski (1), B. Boev (1), A. Zendelska (1), I. Boev (1), M. Hadzi-Nikolova (1), T. Sijakova-Ivanova (1), Gorgi Dimov (1), Nikolinka Doneva (1)

(1) AMBICON Lab, Faculty of Natural and Technical Sciences, University of Goce Delcev, Stip, North Macedonia, dejan.mirakovski@ugd.edu.mk

South-East Europe and particularly continental parts of the Balkan peninsula are among the areas with highest ambient air pollution levels in Europe. Most of the regional capitals exceed the EU annual limit value, and when considering the stricter WHO guidelines, all cities exceed the PM_{2.5} annual mean guideline (Almeida et al, 2020). The objective of our study was to assess Black Carbon concentrations in PM_{2.5} size-segregated aerosols and to estimate the contribution of fossil fuel combustion (BC ff) and biomass burning (BC bb) to equivalent black carbon (eBC) concentrations in the urban area of Skopje, North Macedonia.

Measurements were conducted intermittently at one urban background and one urban traffic-exposed sites, from January to August 2021. The aerosol light absorption coefficients were retrieved using a 7-wavelength aethalometer (Rack Mount Aethalometer Model AE33, Magee Scientific Corp., Barkley, CA, USA). Aethalometer readings were corrected in real-time for multiple scattering in the filter matrix and loading effects, using the DualSpot Technology® (Drinovec et al., 2015). Using the Aethalometer model (Sandradewi et al. 2008), the absorption coefficients produced from the aethalometer were utilized to estimate the contribution of biomass burning and fossil fuel to total BC concentrations. PM_{2.5} samples were collected on PTFE filters using a low volume sampler (Sequential sampling system with automatic filter changer and Peltier cooler, PNS 18, DM-6.1, Comde-Derenda GmbH, Germany) and analysed for potassium (K) and other major and trace elements using an X-Ray fluorescence (NEX CG II EDXRF Spectrometer, Applied Rigaku Technologies, Inc., Tokyo, Japan). One-hour averaged data for fine particulate concentrations (PM_{2.5}), carbon monoxide (CO) and nitrogen dioxide (NO₂) were obtained respectively from a co-located monitoring station, part of the State Monitoring Network, operated by the Ministry of Environment and Physical Planning (MOEPP).

Measured equivalent black carbon concentrations were similar to other pollutants connected with low efficiency combustion processes like PM_{2.5} and CO - exhibiting strong seasonal variation at both sites, ranging from high 6.96 ± 6.82 (urban background) and 6.24 ± 6.54 (traffic exposed site) during the cold season, to significantly lower 1.41 ± 1.16 (urban background) and 2.78 ± 2.03 (traffic exposed site) during the warm season. During the cold season, the mean relative contribution (%) of biomass burning reached 52.18 ± 15.22 % of the total black carbon concentration at the urban background site and 32.35 ± 19.22 % at the traffic-exposed site, and exhibited a strong diurnal pattern with maximum values during the evening and late-night hours. The mean relative contribution of biomass burning significantly lower during the warm season, reaching 16.27 ± 8.28 at the urban background site and 7.65 ± 6.03 % at the traffic-exposed site, with no clear diurnal pattern.

REFERENCES

- Almeida S.M., Manousakas M., Diapouli E., Kertesz Z., Samek L., Hristova E., Segal K., Padilla Alvarez R., Belis C.A., Eleftheriadis K. and The IAEA European Region Study GROUP, 2020. Ambient particulate matter source apportionment using receptor modelling in European and Central Asia urban areas, *Environmental Pollution*, Volume 266, Part 3, <https://doi.org/10.1016/j.envpol.2020.115199>.
- Diapouli, E., Kalogridis, A. C., Markantonaki, C., Vratolis, S., Fetfatzis, P., Colombi, C., and Eleftheriadis, K. 2017. Annual Variability of Black Carbon Concentrations Originating from Biomass and Fossil Fuel Combustion for the Suburban Aerosol in Athens, Greece, *Atmosphere*, 8, 234, <https://doi.org/10.3390/atmos8120234>.
- Drinovec, L., Mocnik, G., Zotter, P., Prevot, A. S. H., Ruckstuhl, C., Coz, E., Rupakheti, M., Sciare, J., Müller, T., Wiedensohler, A. and Hansen, A. D. A. 2015. The “dual-spot” Aethalometer: an improved measurement of aerosol black carbon with realtime loading compensation, *Atmos. Meas. Tech.*, 8, 1965–1979, <https://doi.org/10.5194/amt-8-1965-2015>.
- Kalogridis A-C, Vratolis S., Liakakou E., Gerasopoulos E., Mihalopoulos N. and Eleftheriadis K. 2018. Assessment of wood burning versus fossil fuel contribution to wintertime black carbon and carbon monoxide concentrations in Athens, Greece, *Atmos. Chem. Phys.*, 18, 10219–10236, <https://doi.org/10.5194/acp-18-10219-2018>.
- Sandradewi J., Prevot A.S.H., Weingartner E., Schmidhauser R., Gysel M., Baltensperger U. 2008. A study of wood burning and traffic aerosols in an Alpine valley using a multi-wavelength Aethalometer, *Atmospheric Environment* 42, 101–112, doi:10.1016/j.atmosenv.2007.09.034.