COST Action TD1105 *EuNetAir*

BOOKLET

WORKING GROUPS MEETING

Joint-Exercise Intercomparison Sensors-vs-Analyzers

Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling

hosted by Faculty of Mechanical Engineering, University of Belgrade
16 Kraljice Marije, 11120 Belgrade 35, Serbia

organized by VINCA Institute
and Public Health Institute of Belgrade

Belgrade (Serbia), 13 - 14 October 2015

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COST Action TD1105

European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir

WORKING GROUPS MEETING

Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling

2nd EuNetAir Air Quality Joint-Exercise Intercomparison

Belgrade (Serbia), 13 - 14 October 2015

organized by VINCA Institute and Public Health Institute of Belgrade
hosted by Faculty of Mechanical Engineering, University of Belgrade
16 Kraljice Marije, 11120 Belgrade 35, Serbia

Meeting AGENDA	
12 October 2015 - Monday	
09:00 - 14:00	**Arrival to Belgrade**
15:00 - 17:00	**Installation of Sensors in AQ Monitoring Station - Part 1**
20:30	*Free Dinner*
13 October 2014 - Tuesday	
09:00 - 18:00	***REGISTRATION***
09:00 - 13:00	**Installation of Sensors in AQ Monitoring Station - Part 2**
13:00 - 14:00	*Light Lunch offered by COST Action organization*
14.00 - 15.00	***REGISTRATION***
15.00 - 15.30	**Session 1: Welcome Address**
15.30 - 16.30	**Session 2: Oral Presentations**
16:30 - 17:00	*Coffee Break*
17.00 - 18.00	**Session 3: Oral Presentations**
20:00	*Social Dinner*
14 October 2015 - Wednesday	
09:00 - 17:00	***REGISTRATION***
09:00 - 10:30	**Session 4: Oral Presentations**
10:30 - 11:00	*Coffee-break*
11:00 - 13:00	**Session 5: Oral Presentations**
13:00 - 14:30	*Light Lunch offered by COST Action organization*
14:30 - 16:50	**Session 6: Oral Presentations**
16:50 - 17:00	**Session 7: Conclusions**
17:00	***End of the WG1-WG4 Meeting and Farewell***

COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Background and goals

About COST Action TD1105 *EuNetAir*

COST Action TD 1105 EuNetAir, a Concerted Action on *New Sensing Technologies for Air-Pollution Control and Environmental Sustainability*, is a running Networking funded in the framework *European Cooperation in the field of Scientific and Technical Research* (COST) during 2012-2016.
The main objective of the Concerted Action is to develop new sensing technologies for Air Quality Control at integrated and multidisciplinary scale by coordinated research on nanomaterials, sensor-systems, air-quality modelling and standardised methods for supporting environmental sustainability with a special focus on Small and Medium Enterprises.
This international Networking, coordinated by ENEA (Italy), includes over 120 big institutions from 31 COST Countries (EU-zone: *Austria, Belgium, Bulgaria, Croatia, Czech Republic, Estonia, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Luxembourg, The Former Yugoslav Republic of Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom*) and 7 International Partners Countries (extra-Europe: *Australia, Canada, China, Morocco, Russia, Ukraine, USA*) to create a S&T critical mass in the environmental issues.

About the *WG1-WG4 Meeting* at University of Belgrade, Belgrade, Serbia, 13 - 14 October 2015

The WG1-WG4 Meeting (WGM) will be held on 13-14 October 2015 at Faculty of Mechanical Engineering, University of Belgrade, Belgrade (Serbia) under chairing of Dr. Milena Jovasevic-Stojanovic (MC Member), VINCA Institute, and co-chaired by Dr. Anka Cvetkovic (MC Member), Public Health Institute of Belgrade. The core-issues of the COST Action TD1105 will be surveyed and presented as current results and scientific and technological breakthrough. WG1-WG4 Meeting will discuss on ***Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling*** in an interdisciplinary approach aiming to provide **intercomparison *sensors-versus-analyzers***, harmonization of the environmental measurements and experimental campaigns, exchange of best practices, quality assurance, quality control, data quality, methods and protocols, development of new sensing technologies, modelling of air pollution.
High quality output such as joint-publications of the achieved results of the environmental campaign and discussion of the AQ results to be shared in the Action partnership by future meetings are highly expected. Several teams of the COST Action TD1105 are largely interested and involved by their expression of interest to join on the experimental campaign in Belgrade for Joint-Exercise Intercomparison including the contribution in expertise to the multidisciplinary inter-WGs meeting.

More Information

Dr. Michele Penza
MC Chair/Proposer of COST Action TD1105 EuNetAir
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WORKING GROUPS MEETING

Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling

2nd EuNetAir Air Quality Joint-Exercise Intercomparison

Belgrade (Serbia), 13 - 14 October 2015

organized by VINCA Institute and Public Health Institute of Belgrade

hosted by Faculty of Mechanical Engineering, University of Belgrade
16 Kraljice Marije, 11120 Belgrade 35, Serbia

Action Meeting Programme Committee

Michele Penza, ENEA, Brindisi, Italy
Milena Jovasevic-Stojanovic, VINCA, Belgrade, Serbia
Anka Cvetkovic, Public Health Institute of Belgrade, Serbia
Carlos Borrego, IDAD, University of Aveiro, Portugal
Ana Margarida Costa, IDAD, Aveiro, Portugal
Ivan Nedkov, Bulgarian Academy of Sciences, Sofia, Bulgaria
Dimiter Syrakov, Bulgarian Academy of Sciences, Sofia, Bulgaria
Anton Kock, MCL, Leoben, Austria
Ole Hertel, Aarhus University, Denmark
Kaarle Hameri, University of Helsinki, Finland
Nuria Castell, NILU, Kjeller, Norway
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Andreas Schuetze, Saarland University, Germany
Ingrid Bryntse, SenseAir AB, Sweden
Juan Ramon Morante, IREC, Spain
Marco Alvisi, ENEA, Italy
Corinna Hahn, Eurice GmbH, Saarbrucken, Germany
Juliane Rossbach, Eurice GmbH, Saarbrucken, Germany
Annamaria Demarinis Loiotile, University of Bari, Italy
Dusan Topalovic, VINCA, Belgrade, Serbia
Milos Davidovic, VINCA, Belgrade, Serbia

URL: www.cost.eunetair.it

COST Action TD1105 EuNetAir Steering Committee

Michele Penza, ENEA, Brindisi, Italy - *Action Chair*
Anita Lloyd Spetz, Linkoping University, Sweden - *Action Vice-Chair*
Juan Ramon Morante, IREC, Spain
Andreas Schuetze, Saarland University, Germany
Ole Hertel, Aarhus University, Denmark
Ingrid Bryntse, SenseAir AB, Sweden
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Marco Alvisi, ENEA, Brindisi, Italy
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Ralf Moos, University of Bayreuth, Germany
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Giorgio Sberveglieri, University of Brescia, Italy
Eduard Llobet, Universitat Roviri I Virgili, Tarragona, Spain
Thomas Kuhlbusch, IUTA eV, Duisburg, Germany
Albert Romano-Rodriguez, Universitat de Barcelona (UB), Spain
Carlos Borrego, IDAD, University of Aveiro, Portugal
Annamaria Demarinis Loiotile, University of Bari, Italy - *Secretary*

COST is supported by the EU Framework Programme
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Monday, 12 October 2015

COST Action TD1105 EuNetAir

Joint-Exercise Kick-off at Belgrade *Sensors-vs-Analyzers* using AQ Automatic Monitoring Station
Faculty of Mechanical Engineering, University of Belgrade, 11120 Belgrade 35, Serbia

09:00 - 14:00	**Arrival to Belgrade**
15:00 - 17:00	***Installation of Sensors in AQ Monitoring Station - Part 1*** *Chairperson: Milena Jovasevic-Stojanovic, Local Chair, VINCA, Belgrade, Serbia*
	EuNetAir Partner: Air-Sensor-Box (NO_2, O_3, CO, SO_2, PM, T, RH) *Domenico Suriano, Mario Prato and Michele Penza*, Action WG Member, ENEA, Brindisi, Italy
	EuNetAir Partner: AQMesh Pod Sensor-Box (NO, NO_2, O_3, CO) *Mar Viana and Mariacruz Minguillon*, Action WG Member, CSIC-IDAEA, Barcelona, Spain *Amanda Randle*, AQMesh, Warwickshire, UK
	EuNetAir Partner: Microsensor-Box (NO_2, O_3, p, T, RH) for Air Quality Measurements *Kostas Karatzas*, Aristotle University of Thessaloniki, Greece
	EuNetAir Partner: CMOS Sensor-System for Air Quality Monitoring *Foysol Chowdhury*, Action WG Member, CCMOSS Ltd, Cambridge, UK
	EuNetAir Partner: PM/Gas Sensor-System for Air Quality Monitoring *Milena Jovasevic-Stojanovic,* Action MC Member, VINCA, Belgrade, Serbia
	EuNetAir Partner: VOCs Sensor-System for Air Quality Monitoring *G.Sakale, M.Knite, S.Stepina, E.Liepa, S.Sergejeva*, Riga Technical University, Latvia
20:30	**Free Dinner**

COST
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Tuesday, 13 October 2015

COST Action TD1105 EuNetAir

Joint-Exercise Kick-off at Belgrade *Sensors-vs-Analyzers* using AQ Automatic Monitoring Station
Faculty of Mechanical Engineering, University of Belgrade, 11120 Belgrade 35, Serbia

09:00 - 18:00	**COST Meeting Registration**
9:00 - 13:00	***Installation of Sensors in AQ Monitoring Station - Part 2*** *Chairperson: Anka Cvetkovic, Local Co-Chair, Public Health Institute of Belgrade, Serbia*
	All Partners install sensor-systems in AQ Automatic Monitoring Station (AMS) in Belgrade
13:00 - 14:00	**Lunch offered by COST Action organization**
14:00 - 15:00	**COST Meeting Registration**
15:00 - 15:30	***Session 1: Welcome Address*** *Chairperson: Milena Jovasevic-Stojanovic, Local Chair, VINCA, Belgrade, Serbia*
	Bojan Radak, Institute VINCA Deputy Director, Belgrade, Serbia *Representative from* Public Health Institute of Belgrade Director, Belgrade, Serbia *Natasa Djokic*, Secretary of Environmental Protection, Municipality of Belgrade, Serbia *Representative from* University of Belgrade, Belgrade, Serbia *Michele Penza*, COST Action TD1105 Chair, ENEA, Brindisi, Italy
15:30 - 16:30	***Session 2: Plenary Session*** *Chairperson: Michele Penza, Action Chair - ENEA, Brindisi, Italy*
15:30 - 16:00	**COST Action TD1105: European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability. Overview and Plans** *Michele Penza*, Action Chair, ENEA, Brindisi, Italy
16:00 - 16:30	**Development of Real Time Reactive Oxygen Species Sensors** *Zorane Ristovki*, Faculty of Engineering, Queensland University of Technology, Brisbane, Australia
16:30 - 17:00	**Coffee Break**
17:00 - 18:00	***Session 3: Methods for Air Quality Monitoring*** *Chairperson: Michele Penza, Action Chair - ENEA, Brindisi, Italy*
17:00 - 17:30	**Challenge of an Air Quality and Noise Sensor Network on a Maritime Port** *Carlos Borrego,* Institute of Environment and Development, Aveiro, Portugal
17:30 - 18:00	**Electroanalytical Methods in Marine Aerosols Characterization** *Irena Ciglenecki-Jusic*, Rudjer Boskovic Institute, Zagreb, Croatia
20:00	**Social Dinner**

Wednesday, 14 October 2015

COST Action TD1105 EuNetAir

Joint-Exercise Kick-off at Belgrade *Sensors-vs-Analyzers* using AQ Automatic Monitoring Station
Faculty of Mechanical Engineering, University of Belgrade, 11120 Belgrade 35, Serbia

09:00 - 17:00	**COST Meeting Registration**
09:00 - 10:30	***Session 4: Air Quality Modelling and Environmental Measurements*** *Chairperson: Carlos Borrego, Action MC Member, IDAD, Aveiro, Portugal*
09:00 - 09:30	**Air Quality Modelling with Bulgarian WRF-CMAQ System over Europe - O_3, PM, Meteorology** *Dimiter Syrakov*, Bulgarian Academy of Sciences, Sofia, Bulgaria
09:30 - 10:00	**Air Quality Modelling at Different Scales** *Camillo Silibello*, Project manager, ARIANET srl, Milan, Italy
10:00 - 10:30	**Comparing Sensor Data with the Aid of Self Organizing Maps** *Kostas Karatzas*, Aristotle University of Thessaloniki, Greece
10:30 - 11:00	**Coffee Break**
11:00 - 13:00	***Session 5: Exposure Assessment to Air Pollution*** *Chairperson: Milena Jovasevic-Stojanovic, Local Chair, VINCA, Belgrade, Serbia*
11:00 - 11:30	**School Children's Exposure to Ultrafine Particles: A Cross-Sectional Study in Rural and Urban Sites** *Joao Paulo Teixeira*, National Institute of Health, Porto, Portugal
11:30 - 12:00	**Benzo[a]pyrene Toxicity Equivalent Level and Lifetime Lung Cancer Risk in Belgrade Area** *Anka Cvetkovic (1)*, *Milena Jovasevic-Stojanovic (2)*, *Dragan Marković (3)*, (1) Action MC Member, Public Health Institute of Belgrade, Belgrade, Serbia; (2) Action MC Member, Institute VINCA, Belgrade, Serbia; (3) Faculty for Applied Ecology "Futura", Belgrade, Serbia
12:00 - 12:20	**PM Levels and I/O Ratios of PM in the School in the NIŠ City Center, Serbia** *Visa Tasic*, Mining and Metallurgy Institute, Bor, Serbia
12:20 - 12:40	**Carbon Species in Black Crust of Zagreb Cathedral** *Kristijan Vidovic*, Rudjer Boskovic Institute, Zagreb, Croatia
12:40 - 13:00	**DISCUSSION and NETWORKING**
13:00 - 14:30	**Lunch offered by COST Action organization**
14:30 - 17:00	***Session 6: Sensors and Sensor-Systems for Air Quality Monitoring*** *Chairperson: Michele Penza, Action Chair - ENEA, Brindisi, Italy*
14:30 - 15:00	**Challenges and Requirements for Low Cost Environment Monitoring for Poultry Farms** *Foysol Chowdhury*, Action WG Member, CCMOSS Ltd, Cambridge, UK
15:00 - 15:20	**Comparative Statistical Analyses of Multilinear Regression Models for Calibration of Low-Cost Sensors for Air Pollution Monitoring** *Dušan Topalović, Miloš Davidović, Milena Jovašević-Stojanović*, Action WG Member, Institute Vinca, Belgrade, Serbia

15:20 - 15:40	**Use of European Multicity Model for Creation of NO2 and PM2.5 Base Maps for Belgrade** *Miloš Davidovic, Dušan Topalović, Milena Jovašević-Stojanović*, Action WG Member, Institute Vinca, Belgrade, Serbia
15:40 - 16:00	**Gas Sensing Properties of Pd Nanoparticles on TiO_2 Nanorods** *Erdem Sennik, Onur Alev, Zafer Ziya Ozturk*, Action WG Member, GEBZE, Kocaeli, Turkey
16:00 - 16:20	**Volatile Organic Compounds Source of Information** *G.Sakale, M.Knite, S.Stepina, S.Guzlena, I.Klemenoks*, Riga Technical University, Latvia
16:20 - 16:50	**CITI-SENSE: Citizens Observatory** *Alena Bartonova*, CITI-SENSE Coordinator, NILU, Kjeller, Norway
16:50 - 17:00	**CONCLUSIONS** *Michele Penza*, Action Chair, ENEA, Brindisi, Italy
17:00	***End of the WG1-WG4 Meeting and Farewell***

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WELCOME ADDRESS

This is a great honor and my pleasure to chair and welcome to ALL PARTICIPANTS of the **Working Groups Meeting**, joined to **Air Quality Joint-Exercise Intercomparison**, of our COST Action TD1105 *European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir*.

This COST Meeting - held on 13-14 October 2015 - on ***Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling*** is organized by VINCA Institute and Public Health Institute of Belgrade, supported by **Municipality of Belgrade** and hosted at **Faculty of Mechanical Engineering, University of Belgrade**, with the Local Organizing Support from VINCA Institute, Belgrade, Serbia.

This **WGs Meeting** follows the previous *COST WGs Meeting in Copenhagen* (3-4 October 2013), *in Aveiro* (13-14 October 2014), and it is attended from at least 30 Participants and includes 7 Sessions with 1 Keynote Speaker, 8 Invited Speakers, and 8 Oral Speakers from at least 11 COST Countries. **Intercomparison** was participated by 6 Teams from 6 COST Countries. An international Advisory Board (*Steering Committee*) composed by 22 Members has served with S&T inputs to define Workshop Programme. *Female participants* are as 33% and *Male participants* are as 67% with a quota of *Early Stage Researchers* as 33%.

The concerted COST Action TD1105 *EuNetAir* - related to R&D issues of the air quality monitoring including environmental technologies, nanomaterials, functional materials, gas sensors, smart systems, air-pollution modelling, measurements, methods, standards and protocols - is very pleased to connect international specialists and excellent scientists to create a networking of Pan-European R&D platform from 31 COST Countries and 7 Non-COST Countries. Most part of COST Countries are represented in this Meeting.

Special thanks to **COST Officers**: Dr. Deniz Karaca, *ESSEM Science Officer* and Dr. Andrea Tortajada, *Administrative Officer*, involved to manage policy & administration in our Action.

On behalf of the Action Management Committee, I would like to thank ALL Workshop **Participants**, **Grant Holder**, **Action Scientific Secretary**, **Local Organizing Committee** by VINCA Institute and co-organized by Public Health Institute of Belgrade, and **University of Belgrade**, finally **Municipality of Belgrade**, represented by *Secretary of Environmental Protection of Municipality*, in order to give us the opportunity to disseminate the results of the COST Action TD1105 *EuNetAir* towards a wide international targeted audience involved in the Air Quality Control, with special focus on *Joint-Exercise AQ Intercomparison*, as local hot-issue.

With their valuable scientific work and management, kind availability and great enthusiasm will make our Action Meeting very successful !

Enjoy your *EuNetAir* WGs Meeting at *University of Belgrade* in Belgrade !

Brindisi, 3 October 2015

Michele Penza, ENEA, Brindisi, Italy
COST Action TD1105 Chair
michele.penza@enea.it

EuNetAir COST Action TD1105 Logo

Invited Talk

COST ACTION TD1105: EUROPEAN NETWORK ON NEW SENSING TECHNOLOGIES FOR AIR-POLLUTION CONTROL AND ENVIRONMENTAL SUSTAINABILITY. OVERVIEW AND PLANS

M. Penza and Consortium *EuNetAir*
ENEA - Italian National Agency for New Technologies, Energy, Sustainable Economic Development; Department for Sustainability; Division Technologies and Processes of Materials for Sustainability; Laboratory Functional Materials and Technologies for Sustainable Applications - Brindisi Research Center, PO Box 51 Br-4, I-72100 Brindisi, Italy. Email: michele.penza@enea.it

Abstract

This is a short overview of the COST Action TD1105 *EuNetAir - European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability* - funded in the framework *European Cooperation in the field of Scientific and Technical Research* (COST) during the period 2012-2016.

The main objective of the Concerted Action is to develop new sensing technologies for Air Quality Control at integrated and multidisciplinary scale by coordinated research on nanomaterials, sensor-systems, air-quality modelling and standardised methods for supporting environmental sustainability with a special focus on Small and Medium Enterprises.

This international Networking, coordinated by ENEA (Italy), includes over 120 big institutions and over 200 international experts from 31 COST Countries (EU-zone: *Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Luxembourg, The Former Yugoslav Republic of Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom*) and 7 Non-COST Countries (extra-Europe: *Australia, Canada, China, Morocco, Russia, Ukraine, USA*) to create a S&T critical mass in the environmental issues.

This COST Action [1, 2] (see logo in Fig. 1) will focus on a new detection paradigm based on sensing technologies at low cost for Air Quality Control (AQC) and set up an interdisciplinary top-level coordinated network to define innovative approaches in sensor nanomaterials, gas sensors, devices, wireless sensor-systems, distributed computing, methods, models, standards and protocols for environmental sustainability within the European Research Area (ERA).

The state-of-the-art showed that research on innovative sensing technologies for AQC based on advanced chemical sensors and sensor-systems at low-cost, including functional materials and nanotechnologies for eco-sustainability applications, the outdoor/indoor environment control, olfactometry, air-quality modelling, chemical weather forecasting, and related standardisation methods is performed already at the international level, but still needs serious efforts for coordination to boost new sensing paradigms for research and innovation. Only a close multidisciplinary cooperation will ensure cleaner air in Europe and reduced negative effects on human health for future generations in smart cities, efficient management of green buildings at low CO_2 emissions, and sustainable economic development.

Figure 1. COST Office, ESSEM Domain and Action TD1105 EuNetAir Logo.

Invited Talk

The aim of the Action is to create a cooperative network to explore new sensing technologies for low-cost air-pollution control through field studies and laboratory experiments to transfer the results into preventive real-time control practices and global sustainability for monitoring climate changes and outdoor/indoor energy efficiency. Establishment of such a European network, involving Non-COST key-experts, will enable EU to develop world capabilities in urban sensor technology based on cost-effective nanomaterials and contribute to form a critical mass of researchers suitable for cooperation in science and technology, including training and education, to coordinate outstanding R&D and promote innovation towards industry, and support policy-makers. Main objectives of Action are listed, but not limited to:

- to establish a top-level Pan-European multidisciplinary R&D platform on new sensing paradigm for AQC contributing to sustainable development, green-economy and social welfare
- to create collaborative research teams in the ERA on the new sensing technologies for AQC in an integrated approach to avoid fragmentation of the research efforts
- to train Early Stage Researchers (ESR) and new young scientists in the field for supporting competitiveness of European industry by qualified human potential
- to promote gender balance and involvement of ESR in AQC
- to disseminate R&D results on AQC towards industry community and policy makers as well as general public and high schools.

The Workplan is organized in four complementary Working Groups (WGs), each devoted to a progressive development of synthesis, characterization, fabrication, integration, prototyping, proof-of-concepts, modeling, measurements, methods, standards, tests and application aspects. The four WGs with the specific objectives are:

- **WG1**: *Sensor materials and nanotechnology*
- **WG2**: *Sensors, devices and sensor-systems for AQC*
- **WG3**: *Environmental measurements and air-pollution modeling*
- **WG4**: *Protocols and standardisation methods*

This Action will focus on the study of sensor nanomaterials and nanotechnologies exhibiting unique properties in terms of chemical and thermal stability, high sensitivity, selectivity. Nanosize effects of functional materials will be explored for integration in the gas sensors at low power-consumption. Furthermore, specific nanostructures with tailored sensing properties will be developed for gas sensors and sensor-systems with advanced functionalities.

Selected high-quality research products and innovative technologies developed by the partnership of COST Action TD1105 are shown in the Figure 2.

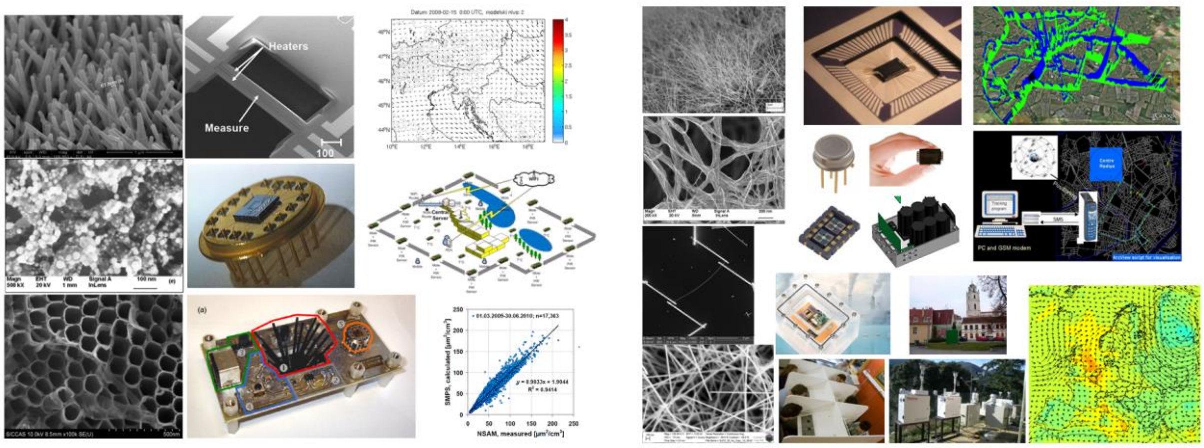

Figure 2. Selected R&D technological products developed by some partners (academia, research institutes, agencies, industry) involved in the COST Action TD1105 *EuNetAir*. Courtesy from *EuNetAir* partnership.

References

1. Action Memorandum of Understanding: http://www.cost.eu/domains_actions/essem/Actions/TD1105
2. Action website: http://www.cost.eunetair.it

Invited Talk

DEVELOPMENT OF REAL TIME REACTIVE OXYGEN SPECIES SENSORS

Z. D. Ristovski[1], S. Stevanovic[1], B. Miljevic[1], F. Hedayet[1], E.M. Simpson[1], J.P. Blinco[1], S.E. Bottle[1]
[1]*School of Chemistry, Physics and Mechanical Engineering, Queensland University of Technology (QUT), 2 George St, Brisbane, Queensland 4001; z.ristovski@qut.edu.au*

Abstract
Pollution in the atmosphere may involve the presence of many components including gases, vapours, smoke and dust (aerosols). Of these components, one factor that can have major significance is the presence of fine and ultra fine particles that can be harmful to human health. Over the last decade the epidemiology of human exposure to ambient particulate matter has clearly established a statistically significant correlation between levels of fine particles and health effects. Studies have now been carried out in several countries and the results have consistently shown a significant impact on human health that is attributable to ambient particles. Despite this clear correlation, the main question that still remains unanswered is: What are the underlying toxicological mechanisms by which fine and ultrafine particles induce adverse health effects?
Some recent insight into this question has arisen from a number of toxicological studies. These studies have demonstrated that particles have the ability to generate free radicals and related reactive oxygen species (ROS). Such species are responsible for driving oxidative stress at sites of deposition and thereby triggering a cascade of events associated with inflammation and, at higher concentrations, cell death. In addition to the particle-induced generation of ROS, several studies have shown that particles may also contain ROS adsorbed on there surface [1]. As such, ROS present a direct cause of oxidative stress and related adverse health effects and their quantitative estimation presents a measure of particulate matter's inherent potential to cause oxidative stress.

One of the main factors restricting research to assess the effects of particle-bound ROS on human health is the lack of a method for routine and continuous ROS measurements. The most common method of quantifying ROS with off-line techniques is in extracts of aerosol particles collected on filters [2]. Due to the reactive nature of ROS, such off-line methods risk severely underestimating the true ROS concentration in particles. Other methods such as particle collection directly into a liquid containing a fluorescent ROS probes (DCHF or PFN) [1, 3] avoid the significant delay from collection, extraction to actual detection but still do not enable continuous real time measurements. Only recently there have been several attempts to develop real-time particle bound ROS monitors. This presentation will discuss recent developments of real time ROS detection methods at QUT and will also give an overview of other instruments and techniques developed elsewhere.

References

1. B. Miljevic, M.F. Heringa, A. Keller, N.K. Meyer, N. K., et al. (2010), "Oxidative Potential of Logwood and Pellet Burning Particles Assessed by a Novel Profluorescent Nitroxide Probe", *Environmental Science & Technology*, **44**(17) 2010, 6601–6607.
2. P. Venkatachari, P.K. Hopke, B.D. Grover, D.J. Eatough, "Measurement of particle-bound reactive oxygen species in Rubidoux aerosols", *Journal of Atmospheric Chemistry* **50** (2005) 49-58.
3. F. Hedayat, S. Stevanovic, B. Miljevic, S. Bottle, Z.D. Ristovski, "Review - Evaluating the Molecular Assays for Measuring the Oxidative Potential of Particulate Matter", *CICEQ* **21**(2) (2015) 201–210.

Invited Talk

CHALLENGES OF AN AIR QUALITY AND NOISE SENSOR NETWORK ON A MARITIME PORT

C. Borrego[1]*, A. M. Costa*[2]*, J. Ginja*[3]*, C. Ribeiro*[4]*, M. Coutinho*[5]
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Abstract

Cargo movement in particular of dry bulk and also the movement of ships and road vehicles are the main port activities with possible impact on air quality through the emission of atmospheric pollutants (Borrego et al., 2007). Air quality monitoring is therefore a decisive tool in the management process of air quality in ports, allowing direct intervention in the functioning of the main sources operating at the port. Also, the diversity of types of cargo, the range of activities, products and services conducted within the port area identify ports as major logistic nodes with implications on the generation and impact of noise. The impact of both air quality and noise are particularly relevant in ports situated adjacent to urban areas, being the most common cause of complaint from the nearby residents (MED, 2015).

This work describes the activity within a Portuguese port, in particular the movement of dry bulk cargo, and analyses the impacts of the atmospheric and noise emission on the nearby population. Moreover, it describes the location of conventional equipment and methodology currently used by Port authorities to address air quality and noise emissions.

The levels of PM10 concentrations measured on fixed monitoring stations at the port area are shown and analysed according to the main port activities. The results of air pollutants monitoring show an increase of PM10 concentrations over the limit value, suggesting a correlation with port activities, in particular with dry bulk movement. Also, the main sources of noise within the port are identified and noise measurements are presented in order to assess the exceedance of legal limits.

Results of air quality and noise monitoring performed with a conventional monitoring approach show the importance to conduct a more detailed assessment within the port vicinity where sensible receptors are located, in order to capture the impacts of the whole ports activity. To achieve this goal, a new air quality monitoring strategy is being studied to include a wide network of air quality and noise sensors in the port area, allowing for real-time monitor on a large number of locations. This network will be integrated in the smart management interface of Port authorities, crossing information with the type of vessels and cargoes and enabling real-time alerts and the adoption of effective prevention and mitigation procedures.

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Invited Talk

ELECTROANALYTICAL METHODS IN MARINE AEROSOLS CHARACTERIZATION

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Electrochemical measurements are along with ICP-MS, the most used but challenging approaches in essential elements analysis and speciation in complex natural samples. There is a wide range of electroanalytical techniques for qualitative and quantitative determination of essential and potentially toxic elements in natural waters. Some examples include: potentiometry, polarography, voltammetry, chronopotentiometry, chronomperometry, etc. These methods, especially voltammetry, have appropriate features to be used as monitoring methods (early warning tools) for assessment of water quality in aqueous systems in general and will be key methods for trace pollutant analyses (sulfur species, organic compounds, trace metals, engineered and natural nanoparticles). Working electrodes, so called voltammetric sensors, have many embodiments that make them specific for detection of above listed natural and anthropogenically introduced compounds in natural environment, enabling their quantitative determination. Electrochemical techniques offer increasing degree of accuracy, decreasing detection limits, simplicity, prompt response, ect. It involves dramatically lower costs than other techniques to reach same sensibility and with automated, portable instrumentation is suitable for fieldwork. In addition, many substances that are analyzed by other techniques use electrochemical detectors.

In the frame of the project „The Sulphur and Carbon Dynamics in the Sea- and Fresh-water Environment“(SPHERE), funded by Croatian science foundation we are studying sulphur (S) and carbon (C) dynamics between different environmental compartments (atmosphere, water, sediment, biota) of the sea- and fresh-water environment. A main focus is on distribution between organic, inorganic, dissolved, colloidal and nanoparticulate fraction. Important part of the project is focused on characterization of marine and freshwater aerosols mainly by electrochemical, chromatographic and ICPMS methods.

In this work simple, direct, and nondestructive electrochemical methods that are developed in our group, were applied for rough and rapid characterization of dissolved organic matter (DOM) i.e. for surface active substances (SAS) (1) and reduced sulphur species (RSS) determination (2), in water soluble fraction of marine aerosols. Electrochemistry is combined with measurements of total and dissolved organic carbon (TOC,DOC) by high temperature catalytic oxidation (HTCO). Study on the DOC and SAS provides an important insight in the content and type of the complex mixture of DOM. Characterization of sulfur fraction, based on measurements of inorganic and organic RSS, comprise a group of compounds that contain sulfur in nominally -II and 0 oxidation states. Some of the most important members of this group in natural waters include sulfide, organic thiols, inorganic and organic di- and polysulfides or polysulfanes and dissolved molecular S0.

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Invited Talk

AIR QUALITY MODELING WITH BULGARIAN WRF-CMAQ SYSTEM OVER EUROPE - O3, PM AND METEOROLOGY

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Abstract

The air quality modelling system WRF-CMAQ running at the National Institute of Meteorology and Hydrology in Sofia was applied to the European domain for the year 2010 in the frame of the Air Quality Model Evaluation International Initiative (AQMEII), Phase 2.

The model system was set up for a domain of 5000x5000 km^2 size with horizontal resolution of 25 km. The mesoscale weather prediction system WRF v.3.3 was run with analysis nudging to NCEP GFS data with spatial resolution of 1_x1_ and time resolution 6 hours. The model was run with well-tried and cited in the literature parametrization schemes, 27 vertical layers with increasing heights up to 50mb. The chemistry transport model CMAQ v. 4.6 was run with the predefined chemical mechanism “cb4_ae4_aq” on 14 vertical levels. The MCIP v.3.6 interface was used to link both models. The anthropogenic emissions are based on TNO-MACC emission inventory, wild fire emissions were estimated in the frame of IS4FIRES project and provided by FMI. The emission module SMOKE was partially used - for estimation of the biogenic emissions and for merging of all type of emissions in a single input file for CMAQ.

Model performance was investigated based on graphical plots and statistical indexes obtained by the webbased model evaluation platform ENSEMBLE, developed and maintained by EC-JRC, Ispra. A preliminary operational model evaluation for ozone and particulate matter was conducted, comparing simulated and observed concentrations at ground level in two different sub-domains of Europe. The monitoring data are from the AIRBASE and EMEP networks. The analysis shows model overestimation for ozone and model underestimation for particulate matter. Trying to understand ozone overestimation, analysis of some meteorological parameters (temperature, precipitation, humidity, PBL height) was also carried out. Vertical profiles of ozone and meteorological parameters were analysed on MOZAIC data at Frankfurt.

Invited Talk

AIR-QUALITY MODELLING AT DIFFERENT SCALES

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Abstract
Air quality (AQ) measurements provide accurate information at the monitoring locations but may lead to inaccurate estimations of air pollutant levels, away from measurement sites, when simple interpolation techniques are used. Low-cost sensors, deployed at many sites permits to improve such results but it should be emphasised that ubiquitous AQ monitoring is practically impossible. On the other side, model outputs are generally less accurate than measurements but provide a complete coverage and include, in a coherent way, emissions, meteorology and physical-chemical processes affecting AQ. Moreover, models can provide information for pollutants not routinely monitored. An optimal integration of both information, by means of data assimilation techniques, produces a more realistic representation of the air quality, leading to a more accurate picture of the health risk anytime and anywhere in the investigated area. Models play a fundamental role in the AQ management process thanks to their ability to predict the impact on pollution levels of emission control strategies, accidental releases from industrial plants and different source categories (source apportionment). A unique model able to cover such range of applications does not exist: depending on the policy area (e.g.: ground-level ozone, acidification and eutrophication, urban air quality, PM mass closure, odours, etc.), the chemical-physical processes to be simulated (e.g. for PM mass closure the selected model should accurately treat both primary and secondary PM components) and the involved spatial and temporal scales, proper AQ models have to be used. The process of determining the degree to which a model and its associated data are an accurate representation of the real world from the perspective of the intended uses of the model is called validation[1]. This process permits to establish the effectiveness of the adopted model and its “fitness for purpose”. It includes several tasks, such as the check of the model capability to simulate real world observations (experiment data sets themselves contain bias and random errors) and the exam of model assumptions/management (processes, algorithms, development, use and maintenance) and data (different sources which may include other models). To support local and national environmental agencies in their activities related to air quality assessment and management, ARIANET S.r.l. has developed and apply different modelling systems, allowing to investigate the processes affecting the AQ. Meaningful examples of application and validation of AQ models at different scales, ranging from the European to the local scale (Naples, Southern Italy urban area), and for various purposes (forecast, assessment of future infrastructures, impact of accidental releases) will be presented. The different complexity of considered processes and consequently of data needed to feed the models and to verify their results will be highlighted.

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Invited Talk

COMPARING SENSOR DATA WITH THE AID OF SELF ORGANIZING MAPS

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Abstract

The Self Organizing Map (SOM) method has been applied in order to investigate relationships between sensor data and to reveal patterns in their behaviour. Data came from the Aveiro AQ sensor intercomparison exercise and was made available via ENEA. This work is part of a Computational Intelligence approach that we employed for further data analysis and modeling.

The Self-organizing map is one of the best known unsupervised neural learning algorithms [1]. The goal of the SOM algorithm is to find prototype vectors that represent the input data set and at the same time depict a continuous mapping from the input space to a lattice, which is considered to be a mathematical construct topologically representing the "interrelationships" between data from the initial data set. An indicative sample of the first results of the analysis is presented in Fig. 1.

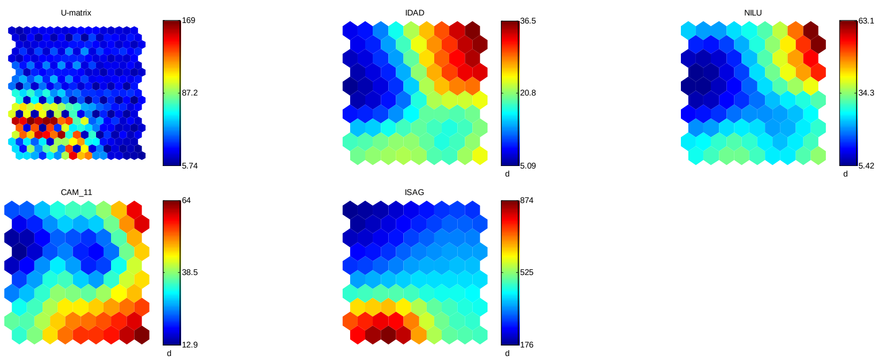

Figure 1: SOM of NO_2 measurements. Data came from IDAD (upper center), NILU (upper right), Cambridge (lower left), ISAG (lower right).

It is evident that IDAD and NILU demonstrate a similar pattern for NO_2, while CAM_11 measurements present some differences (lower right corner of the SOM), with emphasis on the higher concentration values. This may indicate a different sensitivity or even cross reactivity for the related sensors. On the other hand, ISAG measurements present no agreement with the rest of the data included in the specific SOM, thus indicating a completely different (and obviously false) sensor behaviour. The latter is also underlined by the absolute values of ISAG measurements, far bypassing the reference values of IDAD.

The detailed use of SOM in combination with other computational intelligence and statistical methods is expected to increase out insight and understanding concerning sensor behaviour and data interdependencies and patterns.

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Invited Talk

SCHOOL CHILDREN'S EXPOSURE TO ULTRAFINE PARTICLES: A CROSS-SECTIONAL STUDY IN RURAL AND URBAN SITES

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Abstract

Ultrafine particles (UFPs) are particles that are less than 0.1 µm in diameter. Due to their very small size they can penetrate deep into the lungs, and potentially cause more damage than larger particles. Exposure to UFPs may lead to consequences in children due to their increased susceptibility when compared to older individuals. Certain features that may influence UFP number concentrations such as the different characteristics of urbanization and traffic intensity, industrial activity and densely packed housing are characteristically present in urban environments and rarely seen in rural environments [1, 2]. Although there has been some concern regarding the topic, which may be epitomized by several published studies [e.g. 3, 4], there are no studies assessing children exposure to UFPs in urban and rural primary schools in Portugal. The purpose of this study was to assess and determine the sources of indoor UFP number concentrations in urban and rural Portuguese public primary schools with classrooms naturally ventilated. Continuous indoor and outdoor UFPs monitoring was conducted in six urban schools (US) and two rural schools (RS) situated in the north of Portugal during winter period of 2014. The results showed that UFP pollution is present in augmented concentrations in US when compared to RS (10.4×10^3 pt/cc and 5.7×10^3 pt/cc, respectively; p=0.01). Moreover, some basic classroom/school characteristics may influence the concentrations of UFPs in primary schools, such as density of occupation, floor levels closer to the ground, chalk boards, type of furniture or floor covering materials. The obtained concentrations data give an insight on the important role of different traffic emission exposures and can contribute to the design of effective policies and mitigation measures for the protection of public health. This work is supported by the Portuguese Foundation for Science and Technology through ARIA project (PTDC/DTP-SAP/1522/2012).

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Invited Talk

Benzo[a]pyrene Toxicity Equivalent Level and Lifetime Lung Cancer Risk in Belgrade Area, Serbia

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Abstract

Atmospheric polycyclic aromatic hydrocarbons (PAHs) are class of potentially carcinogenic substances, causing respiratory problems [1]. IACR classified benzo[a]pyrene B[a]P as human carcinogens (Group 1) [2]. Benzo[a]pyrene toxicity equivalent **(**BaPeq) value is obtained by multiplying individual PAH concentration by their toxic equivalence factor (TEF) [3]. Toxic effect of some PAHs is stronger, even at much lower concentrations, due to its high TEF [4].

In this paper we determine levels and the total carcinogenic activities (total BaPeq concentrations) for PAH in PM_{10} collected during heating and non-heating season in period 2010-2013 at different sampling sites:

- urban - traffic, located in strong city centre
- urban - traffic and residential heating, boundary of central zone
- rural industrial and residential heating, located in rural area in vicinity of Thermal power plant
- suburban industrial

The highest BaPeq level were found at rural industrial site during the heating season (12.96 ng/m^3) for PM_{10} and the lowest at urban traffic site (0.39 ng/m^3) in non-heating season. The carcinogenic risks for humans are much higher at all sites during heating than in non-heating season. The relative contribution of each PAH to the BaPeq levels shown that B[a]P and DahA dominated the BaPeq levels. The carcinogenicity activity contribution of Ba[a]P was in the range of 52.7-69.3% in both seasons at all sampling sites, while percentage contribution of DahA was in the range 9.7-18.5% [5,6]. All values for the lifetime cancer risk were above target individual lifetime risk, which is 10^{-6} [1].

Keywords: Polycyclic aromatic hydrocarbons Benzo[a]pyrene toxicity, toxic equivalence factor, lifetime cancer risk

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Oral Presentation

PM LEVELS AND I/O RATIOS OF PM IN THE SCHOOL LOCATED IN THE NIŠ CITY CENTER, SERBIA

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Indoor air quality in educational buildings is of great importance since children and students spend a large part of their time in the classrooms. This work presents the results of an ongoing study on schoolchildren exposure to PM in the city of Niš. PM mass concentrations were measured during winter period, from 20 March to 4 April 2013, at primary school VK located in the Niš city center. The average PM_{10} concentration inside the school (54.6 μg/m^3) were higher then outdoors (47.9 μg/m^3). The 24 hours average PM_{10} concentrations exceeded the limit value during 35 % of days outdoors, and 53 % of days indoors. Lower PM_{10} levels found inside VK during no teaching hours confirms that concentrations found during teaching hours can be attributed to resuspension and generation of particles by the presence of pupils inside the school. The 24 hours average $PM_{2.5}$ concentrations exceeded the WHO daily mean guideline value (25 μg/m^3) during 71 % of days outdoors, and 88 % of days indoors. The average PM_{10} I/O ratio was 1.57 during teaching hours, and 1.00 during no teaching hours. These findings are consistent with the results obtained for seven primary schools in Athens that has a similar PM_{10} I/O concentrations ratio (1.65) [1]. Similarly, average $PM_{2.5}$ I/O ratio was 1.11 during teaching hours and 0.90 during no teaching hours. The average of daily $PM_{2.5}$ I/O ratios found at VKduring the winter period is similar to that found in the primary schools in Stockholm (0.94) [2]. Strong correlations between indoor and outdoor PM concentrations during no teaching hours (r>0.8) were observed. That points to considerable influence of air pollution with PM from the outdoor air.
The most likely sources of PM in the Niš city center during winter are traffic and fossil fuels combustion. High PM concentrations together with a large number of days with PM concentrations over limits were observed in both the indoor and outdoor environments. High outdoor PM concentrations, limited ventilation, and resuspension of particles are the most possible reasons for the elevated indoor PM concentrations found in the study. Our results also confirmed that wind speed is the most important meteorological parameter concerning the dispersion of air pollutants in the winter in the Niš city center.

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Oral Presentation

CARBON SPECIES IN BLACK CRUST OF ZAGREB CATHEDRAL

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Abstract
After gaseous pollutants, aerosol derived from combustion processes is recognised to be the main cause of atmospheric pollution in urban environments [1]. Atmospheric pollution is the main agent responsible for the damage encountered on monuments and historical buildings in urban areas [2]. The interaction between the atmosphere and stone monuments leads to the formation of surface layers which generally cause damage to the original materials [3]. Atmospheric composition is of unquestionable importance in the study of the damage produced on building materials of artistic interest, since it directly influences the specific characteristics and entity of the degradation mechanism occurring on the cultural heritage.
Carbonaceous aerosol (organic carbon-OC, and elemental carbon-EC) makes up a large fraction of air particular matter. The presence of carbonaceous particles in the atmosphere play an important role in the overall deterioration of materials [4]. The aim of the paper is to quantify the content of OC and its sub-fraction, water soluble organic carbon (WSOC) in samples of the black crust. The increased organic content may have further aesthetic consequences by changing the color of buildings to warmer tones, particularly browns and yellows [5]. For the quantification of OC and WSOC in the samples of black crust high temperature catalytic oxidation (HTCO) method was used. Our data show that the content of WSOC in OC ranged from 16.56 % to 21.43 %. We also measured the reduced sulphur species [6]. The concentration of inorganic sulphur fraction ranged from 137 nM to 211 nM, and the organic sulphur fraction was from 12.74 nM to 51.66 nM.
Measurement of OC is of fundamental importance for the evaluation of the atmospheric deposition contribution and establishing the pollutant sources responsible for the formation of the damaged layers. The finding demonstrate that damage layers are a record of the environmental changes occurring over time, with their chemical composition reflecting that of the atmospheric combustion sources.

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Oral Presentation

COMPARATIVE STATISTICAL ANALYSIS OF MULTIVARIATE LINEAR REGRESSION MODELS FOR CALIBRATION OF LOW COST SENSORS FOR AIR POLLUTION MONITORING

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Abstract

In the recent years small portable systems with implemented low-cost sensors for detection of particles concentration are increasingly being used to support standard measuring stations. They provide high spatial and temporal resolution of measurements. Based on experience from studies that have used cheap sensors for air pollution monitoring, it was concluded that when one use low-cost sensors in real measurements it is necessary to perform evaluation of their characteristics and calibration procedure.

This paper presents a comparison between *multivariate linear regression* models for calibration of Dylos 1700 device for detecting respirable particles concentration. This device is part of a larger platform for air pollution monitoring. Dylos 1700 device have built in laser that emits light of a certain wavelength. When the particles are in front of the laser, there is an interruption of the laser beam which is reflected through the change of the electric signal in circuits for conditioning and thereby in this way it is possible to detect their presence. It is designed to detect the concentration of two fractions of particles in range > 0.5 μm and > 2.5 μm.

During implementation of the calibration procedures it has been taken into consideration how different meteorological parameters affect on Dylos 1700 device operation. Multivariate linear regression analyzes were conducted at the referent station in New Belgrade This station is urban type station with a height of 85 m. In this study 4 MLR models for PMS particles and 4 MLR models for PML particles were developed. Variables that we used within the models are temperature (T), humidity (H), pressure (p) and measurements from Dylos 1700 devices-PMS (or PML) particle fractions.

From the results it was evident that R^2 parameter that determines the degree of correlation between the output and target data has a higher value for the PMS group in comparison to the PML fraction. Also, based on the values of statistical tests for different models it was concluded that the use of the maximum number of input parameters in the model gives the best results. However, differences in the results are not high and it was noted that humidity has the greatest impact in the linear regression, so when one applying regression methods, for simplicity, it can also be used a model that contains only the humidity as an input parameter.

Oral Presentation

USE OF EUROPEAN MULTICITY MODEL FOR CREATION OF NO2 AND PM2.5 BASE MAPS FOR BELGRADE

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Abstract

Creation of air pollution maps is often hindered by absence of high spatial resolution measurement data of corresponding air pollutants. While the use of low cost measurement platforms can increase the spatial resolution of measurements, additional data is needed in order to obtain realistic spatial patterns in maps. To this purpose it is necessary to include data obtained from the modelling either physical or statistical. Physics dispersion based models require much more data than the statistically based models [1], which can be a serious drawback. Furthermore, type and resolution of needed temporal and spatial data can make the modelling practically impossible for particular urban area.

Land use regression (LUR) modelling, pioneered by Briggs [2], is a statistical modelling technique used to spatially extrapolate concentration of air pollutant over observed area based on values of predictor variables. Underlying principle is that the concentration of air pollutants is strongly correlated to the predictor variables, and that the values of predictor variables are known anywhere in the area of interest. Predictor variables may include traffic intensity, road length in buffer around monitoring site, or other variables that are locally available in GIS [3]. Regarding temporal resolution, LUR models are often used to predict long-term (annual) average concentrations of air pollutants [4], although temporal limits of LUR models can be smaller [5].

European multicity model, developed by Wang et al [1], extended land use approach to model PM2.5 and NO2 pollutants for several European cities. We used this model to create maps for area of Belgrade Master Plan. Main challenges were related to creation of predictor variables for Belgrade out of scarce data. We describe these challenges, how we solved them and main results. For example, detailed traffic data is needed for LUR model, which we created using public transport data (timings and routes) and data from network of automatic counters. The final maps can be checked in a number of ways, for example by checking the range of pollutant concentration. The values obtained for the map have reasonable and realistic concentration ranges of annual average values (about 7 to 58 ug/m3 for NO2 and 17 to 24 ug/m3 PM2.5). Furthermore, obtained values were checked against Belgrade monitoring sites data and accuracy of maps was discussed.

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Oral Presentation

Gas Sensing Properties of Pd Nanoparticles on TiO_2 Nanorods

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Abstract

Among metal oxide-based gas sensors, TiO_2 has excellent sensing properties for various gases [1]. To improve their gas sensing properties such as selectivity, sensitivity, response time and working temperature, metal oxides can be modified with different metals [2, 3].

In this study, TiO_2 nanorods were fabricated by hydrothermal method. Then Pd loaded TiO_2 nanorods (Pd-TiO_2 NRs) were synthesized via chemical vapor deposition (CVD) process as stated in our previous study [3]. The morphologies and structure of the samples were characterized by X-ray diffraction (XRD), scanning electron microscope (SEM) and X-ray photoelectron spectroscopy (XPS). Fig. 1a shows SEM image of Pd loaded TiO_2 nanorods. Both the upper surface and partially the lateral surface of TiO_2 NRs are covered with the matter condensed as spherical nanoparticles. H_2 sensing properties of Pd loaded TiO_2 nanorods device were investigated at 30 ^oC and the sensor response of the device is given in Fig. 1b. Pd loaded TiO_2 nanorods show excellent sensor response for H_2 at 30 ^oC due to "catalytic effect".

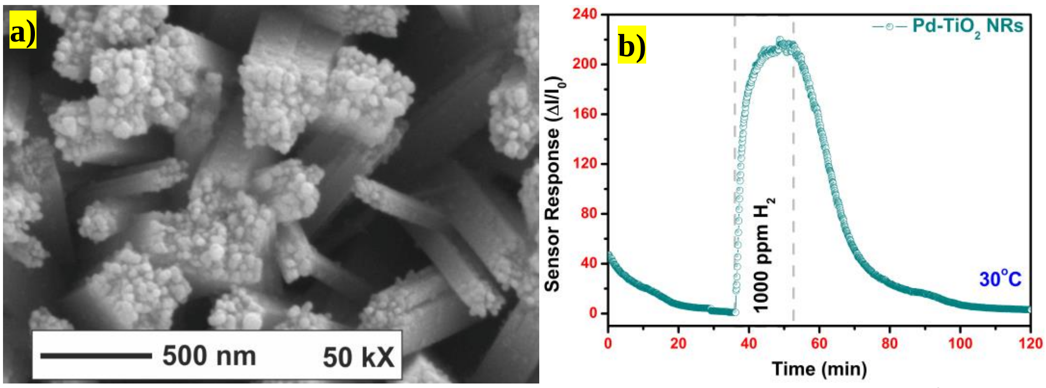

Figure 1. Pd loaded TiO_2 nanorods a) SEM image, b) H_2 sensing property at 30 ^oC.

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Oral Presentation

VOLATILE ORGANIC COMPOUNDS SOURCE OF INFORMATION

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Abstract
Volatile organic compounds (VOC) are generated in a number of processes. Human exhaled VOC can serve as biomarkers for certain disease. Detection and analysis of the biomarkers can help in disease diagnostics by non-invasive way. *Philips* has shown that there are 22 VOC, which can be classified as biomarkers for lung cancer [1] and derivatives of alkanes, alkenes, cyclohexane and benzene have been identified in breath of pulmonary tuberculosis patients [2]. *Mahmoudi* have shown that there are number of VOC, which can indicate about freshness of food [3]. The marker VOC monitoring in fermentation processes of food and beverage production could lead to improvement of process quality control. VOC are one of target compounds to be controlled in the air. There are regulations (directive 2008/50/EC), which limit VOC content in the ambient air indoors and outdoors for health, safety and environmental issues.

Highly sensitive and selective sensors have to be elaborated to read and make use of VOC generated information. One kind of sensors to be applied in VOC detection can be polymer-based nanocomposites. Contrary to metal oxide based gas sensors, polymer based sensor materials operate at room temperature. Can be produced in a simple way like screen-printing, dip coating and electrospinning. These sensors are remarkable with rather good sensitivity: *Ran Y. et.al* demonstrated that 10ppm of DMMP can be sensed by single-walled nanotube and polyaniline composite [4]; *Alizadeh* report results about molecularly imprinted graphene/graphite /PMMA sensor material, which can sense 1.25pmm of nitrobenzene; our research team at Riga Technical University have elaborated conductive filler (carbon black/carbon nanotubes) and polyisoprene or ethylene-vinyl acetate nanocomposites with sensitivity of toluene below 30ppm.

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Invited Talk

CITI-SENSE: CITIZENS OBSERVATORY

A. Bartonova[1] and the CITI-SENSE consortium[2],
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Abstract

With increased abundance of small sensing devices for monitoring physical and chemical parameters of the ambient environment, and with the explosive growth in ways to use personal communication devices, possibilities need to be explored how to combine these opportunities to improve life quality as well as environmental information collection. The European Commission (EC) has seen this opportunity to deliver improvements to European citizens, and at the same time, increase observational capabilities. EC has initiated five projects with the aim to build Citizen's Observatories, in the fields of marine water quality, flood protection, odour nuisance reduction, biosphere reserve management, and urban life quality targeting air pollution, comfort and school indoor environment. The CITI-SENSE project (www.citi-sense.eu; October 2012-September 2016) addresses the last two fields in a combination of science, technology and citizen's actions, with a team of 30 research and industrial partners from Australia, Austria, Belgium, Czech Republic, Israel, Italy, the Netherlands, Norway, Serbia, Slovenia, South Korea, Spain, and the United Kingdom.

The main objective of CITI-SENSE is *to develop "Citizens' Observatories" to empower citizens and citizens' groups*: (i) to contribute to and participate in environmental governance; (ii) to support and influence community and policy priorities and the associated decision making; and (iii) to contribute to European and global monitoring initiatives. Addressing these aims demands new ways to generate and assess environmental information on the environment. Realization of these new ways requires a high degree of inter- and transdisciplinary interaction: Citizen's Observatories have the potential to change the way society generates and uses environmental information, but their development demands significant improvements of today's technologies and ways to interact with the public.

CITI-SENSE started with the notion that existing devices (proprietary solutions of our industrial partners) are readily available for use. However, as we are running a multi-centre multi-provider trial, we first needed to address comparability of devices output, and to develop appropriate communication solutions for sharing the data. Simultaneously, we were developing different kinds of potentially useful products for the public for sharing the expected information in a way that would enable participation in decision-making. Ideally, such developments should be done in co-design with the users. In practice, this means that we have to manage a number of technical as well as societal processes that run in parallel. Interesting questions arise e.g., when we wish to share "our" measurements of air quality with the public that at the same time has access to the monitoring results from the air quality compliance network: how is this seen by the responsible authorities? And how can "the public" use the information?

This paper will provide some examples of challenges we encountered, and will suggest some of the solutions we are choosing to implement.

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COST Action TD1105
European Network on New Sensing Technologies for Air-Pollution Control and Environmental Sustainability - EuNetAir

WORKING GROUPS MEETING

Air Quality Monitoring and Calibration: Horizons in Sensing Technologies, Methods and Modelling 2nd EuNetAir Air Quality Joint-Exercise Intercomparison

organized by Vinca Institute of Nuclear Sciences and Public Health Institute of Belgrade

Belgrade (Serbia), 13-14 March 2015

Workshop Venue:

Kraljice Marije 16, Belgrade, Serbia

Meeting and Travel Information

Local organizer:

Dr Milena Jovašević-Stojanović Vinca Institute of Nuclear Sciences Mike Petrovića Alasa 12-14, Vinča, Beograd, Serbia tel: +381 11 3408695 mob: +381 63 8885075 E-mail: mjovst@vinca.rs	Dr Anka Cvetković Public Health Institute of Belgrade Bulevar Despota Stefana 54 a Belgrade, Serbia tel: +381 11 2078741 E-mail: mjovst@vinca.rs

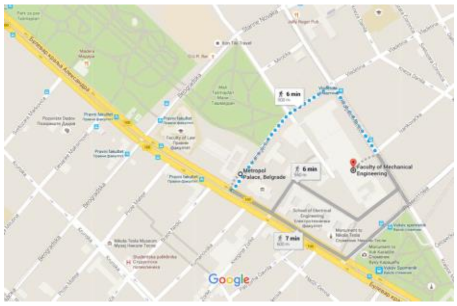
Meeting and Travel Information

Hotel Information

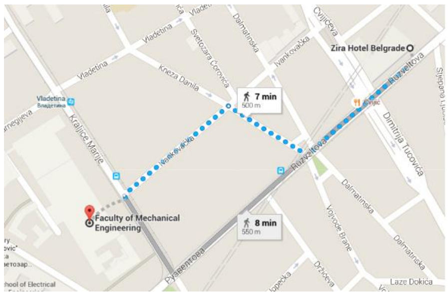
Few hotels and its walking distance from Belgrade Workshop Venue:

University of Belgrade, Mechanical Faculty, Kraljice Marije 16, 11000 Belgrade, Serbia

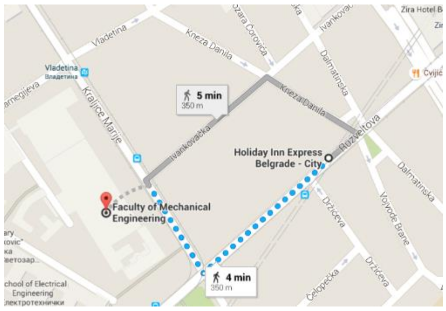
Metopol Palace (****)
Bulevar Kralja Aleksandra 69
Tel.: + 38111 3333100
Fax: +381 11 3333300
Web: http://www.metropolpalace.com/
Prices:
Classic double room (175€/night/person)
Distance from the venue: 6min walk, 500m.



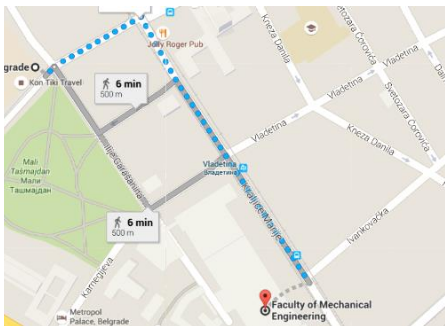
Hotel Zira (****)
Ruzveltova 35
Tel: +381 11 33 14 800
Fax: +381 65 845 4092
Web: http://www.zirahotels.com/en
E-mail: info@zirahotels.com
Prices:
Superior room (99€/night)
Distance from the venue: 7min walk, 500m.



Holiday Inn Express Belgrade - City (***)
Ruzveltova 23
Tel.: +381 11 4144 670
Fax:+381 66 8181 113
Web: www.hiexbelgrade.com
E-mail: info@hiexbelgrade.com
Price:
Single room (67€/night)
Double Room (72€/night)
Distance from the venue: 4min walk, 350m.

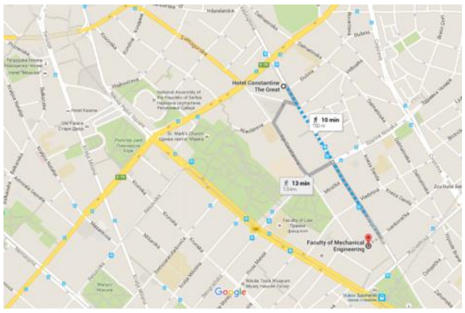


Hotel Tash (***)
Beograska 71
Tel:. +381 11 414 20 50
Web: http://www.hoteltash.com
E-mail: r@hoteltash.com
Price:
Single room (45€/night)
Standard Double Room (65€/night)
Distance from the venue: 6min walk, 500m.



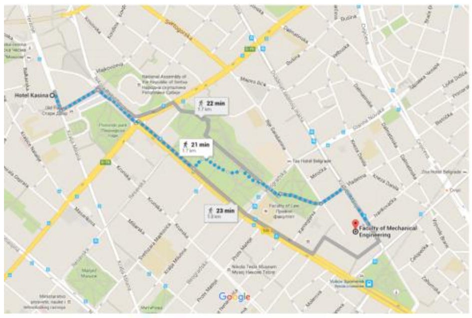
Hotel Constantine The Great (****)

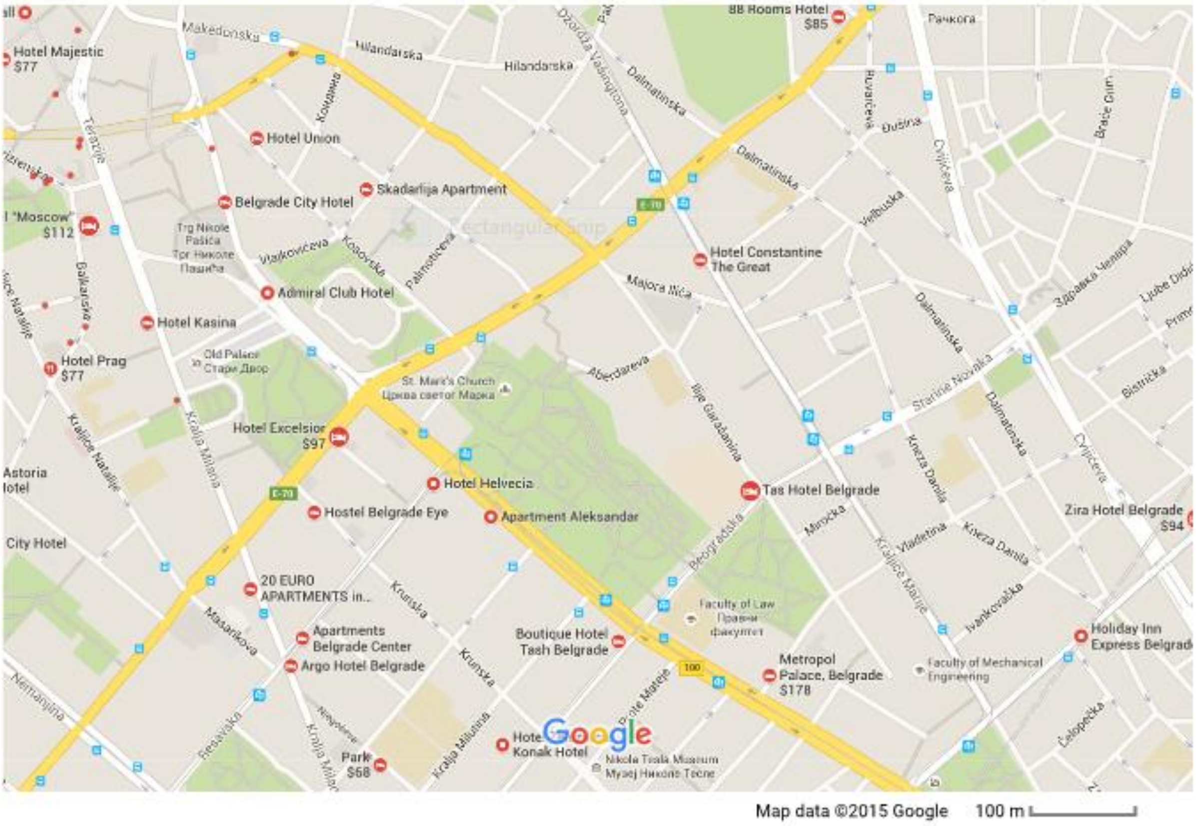
27. marta 12
Tel : +381 11 4144 340
Fax : +381 11 4144 335
Web: http://www.constantinethegreatbelgrade.com/hotel/en
E-mail : info@hotel-constantine.com
Price:
Business single room (86€/night/person)
Distance from the venue: 10min walk, 1000m.



Hotel Kasina (***)

Terazije 25
Tel: +381 11 3235 - 575 (576)
Fax: +381 11 3238 – 257
Web: http://www.hotelkasina.rs/contact.html
E-mail: booking@hotelkasina.rs
Prices:
Comfort rooms (45-65€/night/person)
Apartments ((75-80€/night/person)
Distance from the venue: 21min walk, 1700m.





Meeting Venue Information

University of Belgrade, Faculty of Mechanical Engineering
Kraljice Marije 16, Belgrade
Conference hall/room at fifth floor

,

COST Office
Avenue Louise 149
1050 Brussels, Belgium
t: +32 (0)2 533 3800
f: +32 (0)2 533 3890
office@cost.eu

www.cost.eu

Travel Information

By plane: ***http://www.beg.aero/en/home***

Nikola Tesla airport is 18 km far from the centre of Belgrade and is well connected by buses and taxis.

Local transport form/to Airport from/to Belgrade city center

http://www.beg.aero/en/strana/8811/bus

Mini bus line A1

Route Map: Slavija Square – Airport
Ticket price: RSD 300 (purchased in the bus)
Approximate travel time 30 minutes

A1 — SLAVIJA SQUARE - BELGRADE NIKOLA TESLA AIRPORT / BELGRADE NIKOLA TESLA AIRPORT

Hours	MONDAY - FRIDAY (minutes)	SATURDAY (minutes)	SUNDAY (minutes)	Hours
0	00	00	00	0
1	00	00	00	1
2	00	00	00	2
3				3
4				4
5	00	00	00	5
6	00	00	00	6
7	20 40	20 40	20 40	7
8	00 20 40	00 20 40	00 20 40	8
9	00 20 40	00 20 40	00 20 40	9
10	00 20 40	00 20 40	00 20 40	10
11	00 20 40	00 20 40	00 20 40	11
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18	00 20 40	00 20 40	00 20 40	18
19	30	30	30	19
20	30	30	30	20
21				21
22	00	00	00	22
23	00	00	00	23

All departures performed by Banbus transport company

Timetable valid from February 7, 2013

A1 — SLAVIJA SQUARE - BELGRADE NIKOLA TESLA AIRPORT / BELGRADE NIKOLA TESLA AIRPORT

Hours	MONDAY - FRIDAY (minutes)	SATURDAY (minutes)	SUNDAY (minutes)	Hours
0	00	00	00	0
1	00	00	00	1
2	00	00	00	2
3				3
4				4
5	00	00	00	5
6	00	00	00	6
7	20 40	20 40	20 40	7
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19	30	30	30	19
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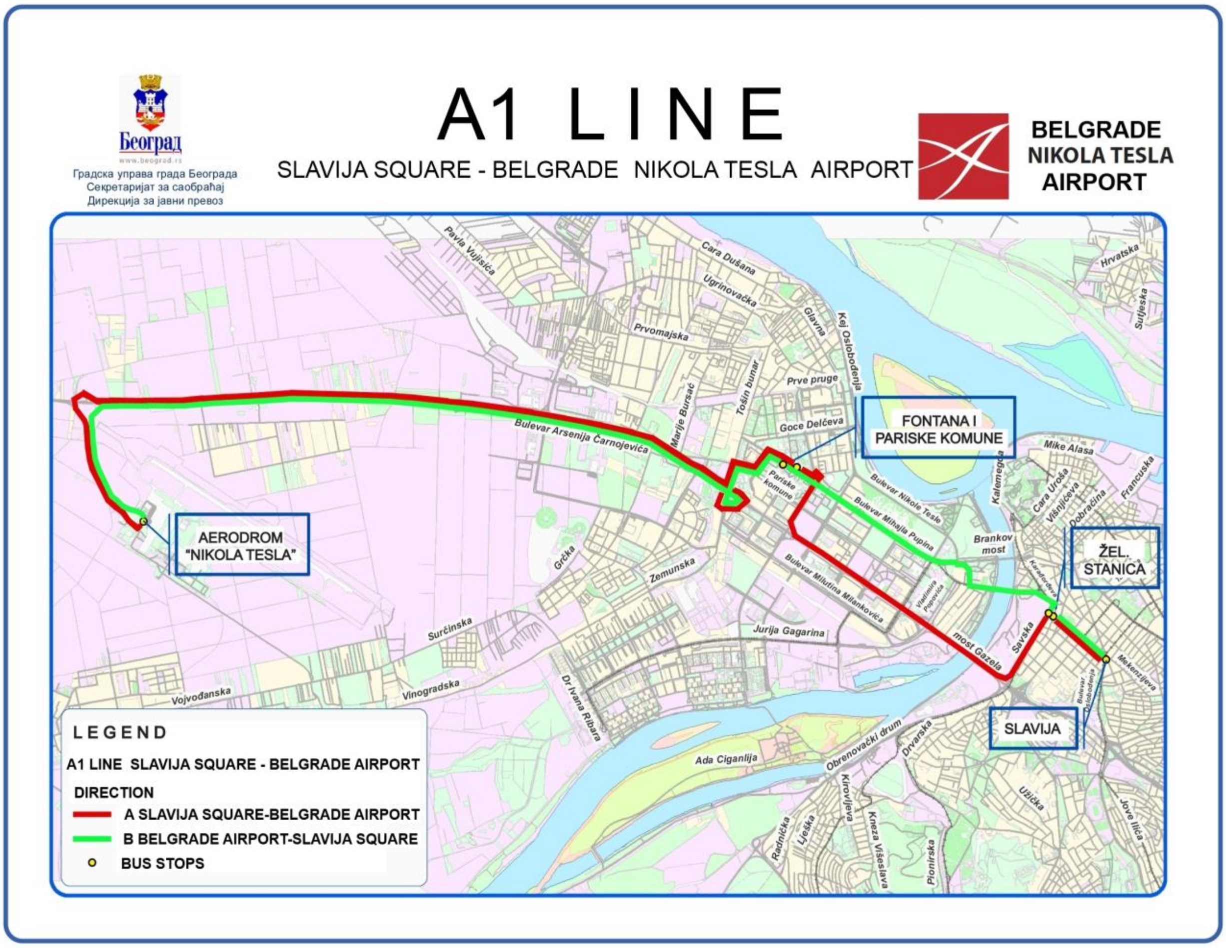
21				21
22	00	00	00	22
23	00	00	00	23

All departures performed by Banbus transport company

Timetable valid from February 7, 2013



PTC Belgrade Line 72

[Airport - Zeleni venac](); [Zeleni venac - Airport]()

Ticket price: RSD 89 (if ticket bought in kiosk), RSD 150 (90 min time-limited ticket).

Other payment options can be found at : https://www.busplus.rs/karte.php

Approximate travel time 30 - 40 minutes

Bus stop at the airport is located opposite the terminal behind the car parking place:

From AIRPORT NIKOLA TESLA to ZELENI VENAC				
hour	MONDAY-FRIDAY (minute)	SATURDAY (minute)	SUNDAY (minute)	hour
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7	07 24 55	07 24 55	07 24 55	7
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10	04 36	04 36	04 36	10
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20	10 41	10 41	10 41	20
21	12 28 44	12 28 44	12 28 44	21
22	16 48	16 48	16 48	22
23	20	20	20	23
0	00	00	00	0

From ZELENI VENAC to AIRPORT NIKOLA TESLA				
hour	MONDAY - FRIDAY (minute)	SATURDAY (minute)	SUNDAY (minute)	hour
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18	21 53	21 53	21 53	18
19	09 25 56	09 25 56	09 25 56	19
20	27 44	27 44	27 44	20
21	00 31	00 31	00 31	21
22	02 33	02 33	02 33	22
23	05 40	05 40	05 40	23

Taxi service from Belgrade Nikola Tesla Airport zones and prices

Prices of Taxi service for zones is noted at:

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Price service from **Belgrade Nikola Tesla Airport to destination in first and second zone is 1400 and 1800 RSD respectively.**

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