

European Federation of Clean Air and  
Environmental Protection Associations (EFCA)  
International Symposium

## **Ultrafine Particles – Air Quality and Climate**

Brussels, Belgium  
May 15 and 16, 2019

BOOK OF ABSTRACTS AND PROGRAM

EFCA



## Venue

Representation of the State of  
Baden-Württemberg to the EU  
Rue Belliard 60-62  
B-1040 Brussels, Belgium



**Baden-Württemberg**

VERTRETUNG DES LANDES BEI DER EUROPÄISCHEN UNION

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Environmental Protection Associations (EFCA)  
International Symposium

## **Ultrafine Particles – Air Quality and Climate**

Brussels, Belgium  
May 15 and 16, 2019

Ultrafine particles (UFP), the nano fraction of airborne particulate matter, are considered to be causing serious health problems and environmental effects. Combustion is a major source, also by producing volatile organic pollutants which are converted in the atmosphere through photochemical reactions.

Increasing applications of man-made nanomaterials add to the problem, e.g. after incineration at the end of their lifetime. A further interest in UFP's results from their specific role in atmospheric processes such as cloud formation and precipitation and, in fact, in climate.

The relation between UFP and human health and that of UFP and climate are both areas of active research and cross-links between these fields are found nowadays. The subtitle of the conference series: **“air quality and climate”** reflects this development.

Present policies to decrease exposure to particulate matter make use of the mass-based metrics PM<sub>10</sub>/PM<sub>2.5</sub>, which do not properly represent all risks for human health. EFCA is, therefore, in favour of the development of a fraction-by-fraction approach on particulate matter, both with respect to size and chemical composition. It already recommended European policymakers the introduction of Black Carbon Particles as additional metric in the Air Quality Directive. The organizers trust that EFCA's 7<sup>th</sup> Ultrafine Particles Symposium 2019 will again feature the most recent scientific progress in the field and so contribute to policy-relevant developments which improve the dialogue with policymakers in Europe. The Symposium has gained visibility by permanently moving to Brussels and attracts an effective mix of EU representatives and scientists. EFCA and KIT, together with GUS and CEEES are pleased to organize this event again. We cordially invite all experts to contribute actively and hope to see you again at the State representation of Baden-Württemberg in Brussels in May 2019.

Thomas Leisner | Chairman

## Wednesday, 15 May

### Opening Plenary

10:00 Representative of the State of Baden-Württemberg | Bodo Lehmann  
EFCA President | Andrzej Jagusiewicz  
GUS President | Karl-Friedrich Ziegahn  
Symposium Chairman | Thomas Leisner

### Keynotes – Session A

10:30 – 11:15 | Europasaal  
Session Chair: Thomas Leisner

10:30 **The role of black carbon in cloud formation and climate**  
Ulrike Lohmann  
ETH Zürich, Switzerland

### Session B – UFP Sources

11:15 – 12:35 | Europasaal  
Session Chair: Ulrike Lohmann

- 11:15 B.1  
**Aviation emissions transport and long-term characterization of ultrafine particles in and around airports. Introduction of the project AVIATOR.**  
Victor Archilla  
Turbojet Engine Test Centre – INTA, Spain
- 11:35 B.2  
**Ultrafine particles around a major airport—attempt to model total ultrafine particle number concentration around Frankfurt Airport**  
Ulf Janicke  
Janicke Consulting, Germany
- 11:55 B.3  
**Ultrafine particles in the lower troposphere: major sources, invisible plumes and meteorological transport processes**  
Wolfgang Junkermann  
Karlsruhe Institute of Technology, Germany
- 12:15 B.4  
**Exposure to nanomaterials in consumer spray products available in the UK**  
Rachel Smith  
Public Health, United Kingdom

12:35 Lunch

### Keynote Session C

13:35 – 14:20 | Europasaal  
Session Chair: Karl-Friedrich Ziegahn

13:35 **Aerosol 3D Profiling Using Compact Particle Measuring Instruments with Balloon and Drone System**  
Kang Ho AHN  
Hanyang University, Korea

### Session D – Ambient UFP Measurements

14:20 – 15:40 | Europasaal  
Session Chair: Harald Saathoff

- 14:20 D.1  
**Ambient UFP Measurements – Options & Limitations of current measurement techniques**  
Frederik Weis  
Palas GmbH, Germany
- 14:40 D.2  
**Monitoring of ultrafine particles in French regional air quality network**  
Shouwen Zhang  
Atmo Hauts-de-France, Lille, France
- 15:00 D.3  
**Pro-inflammatory responses to PM<sub>0.25</sub> from airport and urban traffic emissions at submerged cell-culture conditions: A comparison with air-liquid interface (ALI) culture**  
Rui-Wen He  
RIVM, The Netherlands
- 15:20 D.4  
**Persistent pollution with dangerous nanoparticles in Austrian hospitality venues**  
Manfred Neugerger  
Medical University of Vienna, Austria
- 15:40 Coffee Break

### Session E – Urban UFP

16:00 – 17:40 | Europasaal  
Session Chair: Cordana Pehneć

- 16:00 E.1  
**Characterisation of light-absorbing atmospheric particles in the Brussels sub-urban atmosphere**  
Alexander Mangold  
Royal Meteorological Institute of Belgium, Belgium
- 16:20 E.2  
**Ultrafine Particles in Mexico City Metropolitan Area: a review**  
Beatriz Cardenas  
World Resources Institute, Mexico
- 16:40 E.3  
**New tools for assessing personal exposure near urban air pollution hotspots**  
George N. Tsegas  
Aristotle University of Thessaloniki, Greece
- 17:00 E.4  
**Unlinking summer new particle formation and high ozone episodes**  
Cristina Carnerero  
IDAEA-CSIC, Barcelona, Spain
- 17:20 E.5  
**Assessment of Personal Exposure to Particulate Emissions in Urban Microenvironments**  
Rajasekhar Bala  
National University of Singapore, Singapore

Poster Session F & Buffet

17:40 – 19:30 | Foyer/Patio

- F.1 **MASS CONCENTRATIONS OF WATER-SOLUBLE IONS IN PM2.5 PARTICLE FRACTION MEASURED AT URBAN BACKGROUND SITE IN CROATIA**  
Mirjana Cackovic  
Institute for Medical Research and Occupational Health, Zagreb, Croatia
- F.2 **Metal bioaccessibility and oxidative potential of PM2.5 in Northern France**  
Lamia Moufarrej  
UCEIV, Dunkerque, France
- F.3 **Light absorbing properties of particles extracted from snow samples**  
Claudia Linke  
Karlsruhe Institute of Technology, Germany
- F.4 **Nanoparticle Release from Thermal Decomposition of Polymer Nanocomposites and the Biological Potential of the Emissions**  
Sonja Mühlhopt  
Karlsruhe Institute of Technology, Germany
- F.5 **Novel Method to analyse Ultrafine Particles using an artificial Intelligence Approach**  
Noor Zaitun Yahaya  
Malaysia University, Terengganu, Malaysia
- F.6 **Use of new measurement device to build a high-resolution network in Augsburg city – Smart Air Quality Network-Project**  
Josef Cyrys  
Helmholtz Zentrum München, Institute of Epidemiology, Neuherberg, Germany
- F.7 **Personal exposure of urban traffic policeman in the Klang Valley to benzene. Health Risk Prediction and Chromosomal Damage**  
Juliana Jalaluddin  
University Putra, Malaysia

EXHIBITORS

ETS – European Tech Serv NV



Envicontrol – environmental technologies



Palas GmbH



ENVILYSE GmbH



GRIMM Aerosol Technik Ainring GmbH & Co. KG



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**Thursday, 16 May**

**Keynotes – Session G**

09:00 – 09:45 | Europasaal  
Session Chair: Flemming Cassee

09:00 **Keeping science in UFP policy making – lessons learned from “fake news” spread by (a few) German mass media**  
Nino Kuenzli  
Swiss Tropical and Public Health Institute, Basel, Switzerland

**Keynotes – Session H**

09:45 – 10:30 | Europasaal  
Session Chair: Flemming Cassee

09:45 **Thinking outside the box: how to use the existing science on ultrafine particles to protect against them?**  
Lidia Morawska  
Queensland University of Technology, Brisbane, Australia

10:30 Coffee Break

**Session I – UFP toxicity and epidemiology**

10:45 – 12:25 | Europasaal  
Session Chair: Lidia Morawska

- 10:45 I.1  
**Fine and ultrafine particles from indoor sources – Effects on healthy humans in a controlled exposure study and on lung epithelial cells in vitro**  
Roel Schins  
Leibniz Research Institute for Environmental Medicine, Germany
- 11:05 I.2  
**Chemical characterization and in vitro toxicity on human bronchial epithelial cells BEAS-2B of PM2.5 from an urban site under industrial emission influence**  
Dominique Courcot  
UCEIV, Dunkerque, France
- 11:25 I.3  
**Toxicity of quasi-ultrafine and fine particles: focus on the effects of PM2.5 organic extractable and non-extractable matter fractions**  
Ghidaa Badran  
UCEIV, Dunkerque, France
- 11:45 I.4  
**TESTING OF AEROSOLS FOR LUNG TOXICITY BY IN-VITRO STUDIES AT THE AIR-LIQUID INTERFACE FOR UP TO 24 HOURS**  
Sonja Mülhopt  
Karlsruhe Institute of Technology, Germany
- 12:05 I.5  
**Long-term exposure to ultrafine particles and incidence of cardiovascular and cerebrovascular disease in the EPIC-NL cohort**  
George Downward  
Utrecht University, The Netherlands

12:25 Lunch

## Session J – Integrating actions and soot

13:25 – 14:45 | Europasaal  
Session Chair: Thomas Reichert

- 13:25 J.1  
**Investigation of UFP-Distributions with Stationary and Mobile Measurements at the Düsseldorf Airport**  
Konradin Weber  
Hochschule Düsseldorf, Germany
- 13:45 J.2  
**New Periodical Technical Inspection (N-PTI) for LDV and HDV to guarantee emission quality**  
Andreas Mayer  
VERT, Switzerland
- 14:05 J.3  
**Externalities and opportunities – impact of new transport & heating solutions on air quality in our cities**  
Marcin Lewenstein  
EIT Inno Energy, Poland
- 14:25 J.4  
**UFP-Integrating action for cleaner air and climate protection**  
Andrzej Jagusiewicz, EFCA President, Poland
- 14:45 Coffee Break

## Panel Discussion – Policy Follow up on Ultrafine Particle Regulation

15:00 – 16:30  
Session Chair: Flemming Cassee

### Representatives

European Commission (tbc)

### Lidia Morawska

Queensland University of Technology, Brisbane, Australia

### John Murlis

Environmental Protection UK and EFCA

### Nino Künzli

Swiss Tropical and Public Health Institute, Basel, Switzerland

### Statement

“There are considerable differences in the toxic potency of UFP from various sources when using mass as unifying metric.”

“The toxic potency of UFP when using mass as a dose descriptor differs from PM2.5, often showing (but not always) that UFP cause greater effect. Moreover, the lung shows different response for UFP compared to larger particles.”

“Increased understanding of the importance of chemical composition for toxicological effects of UFPs and the use of surface area rather than mass as dose metric may possibly shed more light on the issue. For practical reasons, using particle number as a predictor may be preferred above mass and surface area.”

“UFPs do not only affect respiratory health alone but do have systemic effects such as on the cardiovascular system more than PM2.5.”

### Symposium Chairman

**Thomas Leisner**

Institute for Meteorology and Climate Research,  
Karlsruhe Institute of Technology, KIT, Germany

### Organizing Committee

**Thomas Reichert**

Fraunhofer ICT and GUS, Past President of EFCA, Germany

**Harald Saathoff**

Karlsruhe Institute of Technology (KIT), Germany

**Klara Langer**

Karlsruhe Institute of Technology (KIT), Germany

**Sabine Aref**

Gesellschaft für Umweltsimulation (GUS), Germany

**Angela Richter**

Helmholtz Gemeinschaft, Brussels Office, Belgium

**Claudia Mohr**

Stockholm University, Sweden

**Davy Pissoot**

The Confederation of European Environmental  
Engineering Societies, (CEEES)

### Proceedings

Presentations and Posters will be published electronically after the Symposium.

**Abdurrahman Bayram**, TUNCAP, Turkey

**John Bynorth**, EPS, Scotland

**Giuseppe Fumarola**, CSIA/ATI, Italy

**Marie Haeger-Eugensson**, SCAS, Sweden

**Rachel Heijne**, VVM-Clan, The Netherlands

**Andrzej Jagusiewicz**, PIGE, Poland

**Andrea von Känel**, Cercl'Air, Switzerland

**Isabelle Roussel**, APPA, France

**Walter Kofler**, ASASPP, Austria

**Anu Kousa**, FAPPS, Finland

**Richard Mills**, IUAPPA, United Kingdom

**John Murlis**, EP-UK, United Kingdom

**Rudolf Neuroth**, KRdL in VDI and DIN, Germany

**Gordana Peh nec**, CAPP A, Croatia

**Sander Teeuwisse**, VVM-Clan, The Netherlands

**Karl-Friedrich Ziegahn**, KIT and GUS, Germany

**Urs Baltensperger**, Paul Scherrer Institut,  
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**Flemming Cassee**, Dutch National Institute for Public Health and the Environment  
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**Wolfgang Kreyling**, Helmholtz Center for Environment and Health,  
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**Stephan Leinert**, Luftqualitätsuntersuchungen Landesamt für Natur,  
Umwelt und Verbraucherschutz NRW (LANUV)

**Manfred Neuberger**, Austrian Academy of Science (CCAQ) &  
Medical University of Vienna (CPH), Austria

**Xavier Querol**, Consejo Superior de Investigaciones Científicas (CSIC),  
Barcelona, Spain

**Rachel Smith**, Nanotoxicology Research Centre,  
Oxfordshire, United Kingdom

**Claire Segala**, SEPIA, Paris, France

**Ulrich Teipel**, Department of Particle Technology,  
Technical University Nürnberg and University Ulm, Germany

**Vladimira Vadjic**, Institute for Medical Research and Occupational Health,  
Zagreb, Croatia

**Bernhard Vogel**, Institute for Meteorology and Climate Research,  
Karlsruhe Institute of Technology, KIT,  
Germany

**Marion Wichmann-Fiebig**, Federal Environmental Agency,  
Dessau-Roßlau, Germany

#### Presentation

### The role of black carbon in cloud formation and climate

Ulrike Lohmann, Franz Friebe, Zamin A. Kanji, Fabian Mahrt, Amewu A. Mensah, David Neubauer  
Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland

#### ABSTRACT

Soot particles are a major anthropogenic pollutant produced as by-product of incomplete combustion of biomass and fossil fuel. Soot particles vary greatly in their physical and chemical parameters depending on their origin. Soot is important for many processes, including air quality, atmospheric chemistry, global climate and human health. Due to its small size, black carbon is a nanoparticle that can penetrate into the lungs of humans and animals and cause respiratory diseases.

The complex physical and chemical properties, however, make an analytical assessment of the impact of soot on these processes difficult, resulting in large uncertainties. According to some studies assessing the climate impact of soot, it is the second most important radiative forcing agent after carbon dioxide. Its climate impact is two-fold: Soot is the only aerosol that causes a warming of the climate because it absorbs solar radiation and locally heats the atmosphere. It also causes a positive radiative forcing if deposited on snow and ice.

Soot particles also indirectly affect climate by changing cloud properties. A quantification to what extent soot-cloud interactions lead to a positive or negative RF remains an area of active research. There are both better cloud condensation nuclei (CCN) and better ice nucleating particles (INP) than soot. However, soot is the aerosol particle with the longest lifetime and therefore is transported to higher altitudes where cirrus clouds prevail. At the same time aviation emissions denote an in-situ source of soot particles within the upper troposphere. While the soot particles initially emitted by aircrafts are too small to be efficient INPs, they can coagulate into larger aggregates and change their properties during atmospheric aging. Likewise, new experimental findings suggest that soot particles can be CCN-active after several hours of exposure to atmospheric ozone concentrations. The importance of both pathways of soot-cloud interactions is estimated with our global coupled aerosol-climate model and will be presented in this talk.

## Presentation

## Aviation emissions transport and long-term characterization of ultrafine particles in and around airports. Introduction of the project AVIATOR.

Victor Archilla

Turbojet Engine Test Centre – INTA, Spain

### ABSTRACT

Emissions from aircraft have adverse effects on air quality in and around airports and can contribute to public health concerns within neighboring communities. Routine air quality monitoring at airports generally focus on regulated air pollutants. However, recent work has shown that aircraft exhaust emissions are a major source of UFP ( $<0.1\mu\text{m}$ ) in and around airports. This is creating significant concern as the health and environmental impact of UFP is currently insufficiently understood. AVIATOR (Assessing aViation emission Impact on local Air quality at airports: TOwards Regulation) is a European proposal which will adopt a multi-level measurement, modelling and assessment approach to develop an improved description and quantification of the relevant aircraft engine emissions, and their impact on air quality under different climatic conditions. Engine generated particulate matter (PM) and gaseous emissions in test-cell and on-wing from an in-service aircraft will be measured to determine pollutant plume evolution from the engine and APU exhaust. This will provide an enhanced understanding of emitted pollutants, and the scalability between the regulatory test-cell and real-world environments. Specific attention will be focused on non-volatile PM and volatile PM (down to  $<10\text{ nm}$ ), and volatile PM gaseous precursors. AVIATOR will develop and deploy across multiple airports, a proof-of-concept low-cost sensor network for the monitoring of ultra-fine particles (UFP), total PM and gaseous species such as  $\text{NO}_x$  and  $\text{SO}_x$ , across airport and surrounding communities. Transport of emissions from aircraft engines and APU will be monitored in this complex environment through high-fidelity and sensor measurements. Measurement campaigns will be complemented by high-fidelity modelling of aircraft exhaust dynamics, and microphysical and chemical processes within the plume. Inter-connected process models will be applied and new validated parameterisations of the critical processes determined. AVIATOR will develop improved guidance on measuring and modelling the impact of aircraft emissions with specific reference to UFP.

## Presentation

## Ultrafine particles around a major airport – attempt to model total ultrafine particle number concentration around Frankfurt Airport

Ulf Janicke<sup>1</sup>, Helmut Lorentz<sup>2</sup>, Hermann Jakobs<sup>3</sup>, Wolfram Schmidt<sup>1</sup>, Pia Hellebrandt<sup>4</sup>, Matthias Ketzel<sup>5</sup>, Holger Gerwig<sup>6</sup>

<sup>1</sup>Janicke Consulting, Environmental Physics, Germany

<sup>2</sup>Ingenieurbüro Lohmeyer GmbH & Co. KG, Germany

<sup>3</sup>Rhenish Institute for Environmental Research at the University of Cologne, Germany

<sup>4</sup>MUVEDA, Germany

<sup>5</sup>Aarhus University, Denmark

<sup>6</sup>German Environment Agency

### ABSTRACT

The German Environment Agency (UBA) funded the project “Influence of a major airport on temporal and spatial distributions of outdoor air concentrations of ultrafine dust  $<100\text{ nm}$  to describe the potential exposure in the vicinity - including other air pollutants (soot, nitrogen oxides and particulate matter (PM<sub>2.5</sub> and PM<sub>10</sub>))”, UFOPLAN 3716 52 200 0. Total UFP number concentration for the year 2015 at and around Frankfurt Airport (FRA) was estimated using a combination of established small-scale (LASAT/LASPORT) and large-scale modelling (EURAD, MADE). Emissions were determined for aircraft traffic, road traffic, airport ground services and regional/mesoscale background using standard national and international inventories (HBEFA, ICAO, GRETA) and specific data obtained from the airport. Model outputs were series of successive 3-dimensional hourly mean concentrations apportioned to aircraft, airport, motor traffic and background.

The model results suggest that aircraft main engines are the dominant source of UFP at the airport. Aircraft up to 3'000 ft (about 230'000 LTOs) plus airport-bound sources yield an annual nvPM emission of  $1\text{e}+24$  particles, about 90% of which are due to aircraft main engines. According to the model results, long-time averages of UFP number concentration are dominated by background contributions at locations further away from the airport, while the airport contribution to hourly mean concentrations can be significant even in some distance from the airport.

An important aim of the project was to identify shortcomings of current state-of-the-art emission and concentration modelling of UFP in the context of airports. Here, inconsistent UFP diameter ranges in the databases, models and measurements are of relevance, likewise differences in the considered UFP characterisation and measuring method, in particular volatile versus non-volatile fractions. On a more advanced level, current limitations in knowledge and capabilities of local models to address UFP transformation processes play a role.

## Presentation

## Ultrafine particles in the lower troposphere: major sources, invisible plumes and meteorological transport processes

Wolfgang Junkermann<sup>1,2</sup> and Jorg Hacker<sup>2,3</sup>

<sup>1</sup>Karlsruhe Institute of Technology,

<sup>2</sup>Airborne Research Australia,

<sup>3</sup>Flinders University Adelaide

### ABSTRACT

Ultrafine particles in the atmosphere are key factors for aerosol cloud interaction as they affect cloud droplet size distributions, latent heat transport into elevated layers via droplet evaporation and precipitation properties via delayed raindrop generation and possibly invigoration of torrential rains. They are spatially and temporarily highly uneven distributed, suggesting the presence of strong sources either for primary particle emissions or for particle precursor materials. Airborne investigations now allowed to identify major anthropogenic primary particle sources, their strength and contribution to the ultrafine particle budget. Current industrial flue gas cleaning technologies favor the production of nucleation mode aerosol by gas to particle conversion which is emitted into mid elevations of the planetary boundary layer, transported over hundreds of km and vertically mixed by thermal convection on different time scales. These sources also emit a suitable mixture of sulphur and nitrogen compounds and ammonia, key components for aerosol nucleation from gas to particle conversion. Meteorological transport and the results of three dimensional in situ measurements explain both the spatial and temporal patterns of number and size distributions of ultrafine nucleation mode particles observed. Budget studies allow a comparison with recent emission scenarios. Results from clean and polluted environments and the potential impact of these ultrafine particles on the hydrological cycle will be discussed.

## Presentation

## Exposure to nanomaterials in consumer spray products available in the UK

Matthew D. Wright, Adam Laycock, Tim Marczyklo, Rachel Smith

Public Health England, Centre for Radiation, Chemical and Environmental Hazards, Harwell Science Campus, Oxfordshire, UK

### ABSTRACT

Products containing nanomaterials (NMs) (size < 100 nanometres) are rapidly entering the market, however little is known about inhalation exposures to NMs from their use. Here, we analysed representative consumer spray products available in the UK that claim (or are expected) to contain NMs, to assess potential NM exposure levels during use. In the absence of a UK-focused product inventory, we searched "The Nanodatabase" (nanodb.dk), which listed 269 (out of 3001) products for which inhalation was identified as an exposure pathway. None were available over-the-counter at large stores, but 40 were available on ".co.uk" websites (mainly Amazon). We obtained a representative sample (based on product type and claimed content e.g. silver, silica, gold) and found that 12 out of 16 products contained detectable NMs. We used a multi-method approach to characterise the NMs; inductively-coupled plasma mass spectrometry (ICP-MS), ultraviolet-visible spectroscopy and energy-dispersive x-ray spectroscopy to assess NM composition, and dynamic light scattering, nanoparticle tracking analysis, transmission electron microscopy and single particle ICP-MS to determine particle size and shape. The sizes of the airborne particles/droplets produced by spraying a sub-set (6) of these products were measured using aerodynamic and mobility particle sizers, demonstrating the presence of inhalable aerosols. Whilst 5 out of 6 products clearly contained NMs, only 3 produced aerosols in the nano-size range, suggesting that other constituents (e.g. solvent, fragrance) make up the bulk of the aerosol mass. Using the data generated, quantities of NMs inhaled when using these products can be estimated, which is important for appropriate risk characterisation.

Work funded by the UK National Institute for Health Research - Health Impact of Environmental Hazards HPRU.

## Presentation

## Aerosol 3D Profiling Using Compact Particle Measuring Instruments with Balloon and Drone System

Kang-Ho Ahn

Department of Mechanical Engineering, Hanyang University, ERICA Campus, Ansan, R. of Korea  
khahn@hanyang.ac.kr

### ABSTRACT

Aerosol profiling using compact mobile instrument is becoming important for the study of global climate changes, new particle formation, and public health. Manned airplane measurement has been one of the best methods to understand the particles in the high altitude. However, this airplane experiment costs a lot and has some limitations, i.e., no-fly zones, bad weather conditions, low altitude flight limitation, and so on. To overcome some of these limitations, new particle measurement methods have been developed using balloon and drones with miniaturized particle counters.

During this research, a light weight optical particle counter (Hy-OPC) with less than 300 g and a compact condensation particle counter (Hy-CPC) with 3.5 nm cut-off size have been developed. These instruments can be operated at low pressure and temperature (-25°C) conditions. A hand-held scanning mobility particle sizer (Hy-SMPS) with soft X-ray has also been developed for the new particle formation study with drone and balloon. With these particle instruments, temperature, pressure, GPS, and wind speed and direction sensors are added in the package. A communication system and ground control stations has also been developed.

Using these compact instrument package, the aerosol and wind vertical distribution profile has been measured with tethered balloon ( 2 km a.g.l.), sounding balloon ( 8 km a.g.l.), and drones (2.5 km a.g.l.). Some of the particle flux distribution and the new particle formation vertical profile measurement result with Hy-SMPS will be presented.

## Presentation

## Ambient UFP Measurements – Options & Limitations of current measurement techniques

Frederik Weis\*, Maximilian Weiß  
Palas GmbH, 76229 Karlsruhe, Germany

### ABSTRACT

Air pollution due to particulate matter, especially ultrafine particles, and the related negative effects (health problems, economic damages) has become one of the major problems our society is faced with today. In order to be able to investigate and to assess the real exposition of the general public in a comprehensive way, the performance of precise and accurate measurements of particulate matter is an essential part of air pollution control.

For the monitoring of ultrafine and engineered nanoparticles, typically Condensation Particle Counters and Differential Electric Mobility Spectrometers are used. Depending on the aim of research the requirements on the monitoring instruments might be significantly different. Whereas for a general approach a low time resolution and higher detection limit might be acceptable, a more detailed analysis and source appointment desire detection limits down to 1nm, 1s time resolution or differentiation between volatile and non-volatile components. This presentation will show and discuss the possibilities and limitations of currently available instruments based on the examples from airport measurements or ship emissions.

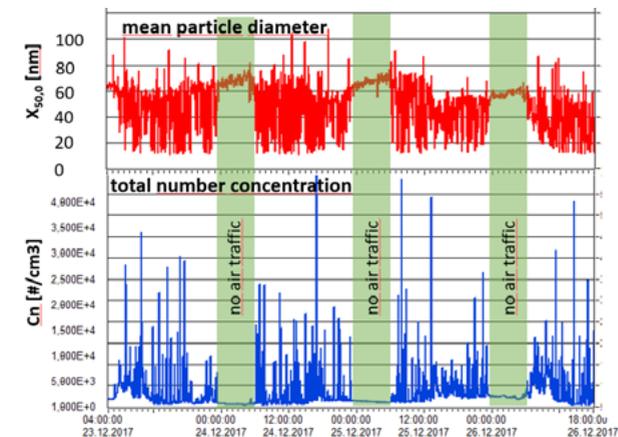


Fig. 1: Total number concentration and mean particle diameter for airport measurements

## Presentation

## Monitoring of ultrafine particles in French regional air quality network

S. Zhang<sup>1\*</sup>, T. Aleixo<sup>2</sup>, A. Thomasson<sup>3</sup>, P.Y. Guernion<sup>4</sup>, F. Pin<sup>4</sup>, B. Mesbah<sup>2</sup>, F. Roze<sup>3</sup>, F. Chevrier<sup>4</sup>, V. Pouchain<sup>1</sup>, M. Dalle<sup>5</sup> and O. Le Bihan<sup>5</sup>

<sup>1</sup>Atmo Hauts-de-France, 59044, Lille, France

<sup>2</sup>AtmoSud, 13294, Marseille, France

<sup>3</sup>Atmo Auvergne-Rhône-Alpes, 69500, Bron, France

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<sup>5</sup>INERIS, 60550, Verneuil-en-Halatte, France

\*Speaker's email: s.zhang@atmo-hdf.fr

### ABSTRACT

Monitoring of ultrafine particles (UFP) in the ambient air is ongoing since 2012 in France. A national working group was created in 2014, including nowadays five French regional air quality monitoring networks. The main instrument selected to monitor UFP is the particle sizer "UFP-3031" (TSI Inc.). It measures the particle number concentration between 20 and 800 nm with six size channels. Two intercomparisons were organized in 2014 and 2015, which evaluated the accuracy of this instrument through a comparison with other techniques (such as Scanning Mobility Particle Sizer, SMPS), and through uncertainty calculations. Recently, several networks have been also equipped with CPC (condensation particle counter) to be able to measure the total UFP number concentration from 7 nm.

This work presents the main results of short and long-term measurement of UFP which have been carried out in various environments: urban/traffic sites, near heavy industry zones (Dunkerque and Fos-sur-Mer in northern and southern France, respectively), near harbor area (Nice)... For urban/traffic environment, the number concentration and size distribution are compared at the national level; it appears that they vary significantly depending on the influence of road traffic around the site. The concentration levels near traffic sites are at least twice than in the urban area, especially for UFP smaller than 50 nm (Figure 1).

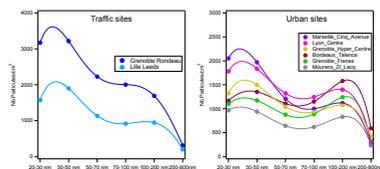


Figure 1: The average UFP's size distribution of traffic and urban sites in France

Additionally, the UFP measurement also makes it possible to improve the identification of specific sources and to understand the atmospheric physicochemical phenomena. The relationship between UFP and industrial emissions, ferries, forest fires was clearly identified in different places in France. During summer, the UFP monitoring also shows the formation of new particles (between 20-30 nm or smaller) in the afternoon, due to photochemical reactions.

From 2019, the French national strategy on UFP will start putting a particular emphasis on the impact of UFP on human health.

## Presentation

## Pro-inflammatory responses to PM<sub>0.25</sub> from airport and urban traffic emissions

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### ABSTRACT

Airport particulate matter (PM) emissions are the known source of air pollution in the proximity of an airport. Often large airports are located near metropolises, and airport emissions may have a potentially considerable impact on public health in the surrounding urban areas. However, little is known about the sources that are relevant to air quality and health in the vicinity of airports. Therefore, the effect of the chemical composition of airport-related PM on adverse health risks was investigated in comparison to urban traffic emissions.

PM<sub>0.25</sub> were collected at the Los Angeles International Airport (LAX) and at a central Los Angeles site (USC campus), along with PM<sub>2.5</sub> collected directly from turbine and diesel engines. The chemical composition, oxidative potential (OP) of particles as well as the reactive oxygen species (ROS) activity, inflammatory potential (IL 6, IL 8 and TNF- $\alpha$ ) release and cytotoxicity on human bronchial epithelial (16HBE) cells were assessed. Chemical composition measurements confirmed that aircraft emissions were the major source to LAX PM<sub>0.25</sub>, while the sources of USC samples were more complex, including traffic emissions, suspended road and soil dust, and secondary sulfate. The traffic-related transition metals (Fe and Cu) in LAX and USC samples mainly affected OP values of particles, while multiple factors such as compositions, size distribution and internalized amount of particles contributed to the promotion of ROS generation in 16HBE cells during 4 h exposure. Internalized particles in cells might also play an important role in activating inflammatory responses during 20 h recovery period, with LAX particles being more potent.

Our results demonstrate considerable toxicity of airport-related particles, even at low exposure concentrations, which suggests that airport emission as source of PM<sub>0.25</sub> may also contribute to the adverse effects on public health attributable to PM.

## Presentation

## Persistent pollution with dangerous nanoparticles in Austrian hospitality venues

Neuberger Manfred\*

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### ABSTRACT

**Motivation:** After the introduction of a partial smoking ban in the Austrian hospitality industry in 2009 poor compliance and pollution with fine particles in 47 Viennese smoking rooms and 23 adjacent non-smoking rooms was found ([www.mdpi.com/2073-4433/2/2/171](http://www.mdpi.com/2073-4433/2/2/171)). Because PM1 correlated with air nicotine and was more discriminative than PM2.5, a second survey in 134 rooms of hospitality venues in Vienna included particle number (PN) and lung deposited surface area ([www.nature.com/articles/jes201322.pdf](http://www.nature.com/articles/jes201322.pdf)). The high pollution with ultrafines found even in the nonsmoking sections, contributed to the legislation of 2015, which banned smoking without exceptions. But a new government cancelled this ban before it entered into force in 2018, arguing with improvements of compliance. Therefore a comparable survey was performed in Graz (Sep.-Nov.) and smaller towns in Lower Austria (Nov.-Dec. 2018).

**Methods:** All indoor samples were taken unannounced and secretly. Immediately after indoor sampling one outdoor sample was taken on the street, where the enterprise was located. In Graz one non-smoking venue was used as an indoor reference for 26 venues where PN was measured in the smoking room and an adjacent non-smoking room. For 20 rural venues in Lower Austria another nonsmoking venue was used as indoor reference. In each room samples were collected for at least 20 minutes by a diffusion size classifier (minidisc G3\_016, matter aerosol).

**Results:** PN/mm<sup>3</sup> in smoking rooms, adjacent non-smoking rooms and outdoors were

		smoking room	non-smoking room	street
Graz (2018)	n	26	26	26
	mean	152	55	10.5
	median	81	37	10.0
Lower Austria	n	20	20	20
	mean	74	41	6.5
	median	46	25	5.7

Even with doors closed during sampling, transfer of ultrafines from smoking to non-smoking rooms was evident. In non-smoking venues without adjacent smoking rooms, levels were below outdoor concentrations.

**Conclusion:** Contamination of Austrian bars, discos, pubs, cafes and restaurants is still unacceptable.

### Acknowledgement:

Graz data collection: Martin Stoiber, data evaluation: Peter Tappler (IBO Innenraumanalytik OG)  
Lower Austria data collection: Aaron Hartl, data evaluation: Peter Tappler (IBO Innenraumanalytik OG)

## Presentation

## Characterisation of light-absorbing atmospheric particles in the Brussels sub-urban atmosphere

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### ABSTRACT

The particle composition is important for air quality studies in the urban atmosphere. In particular, particles smaller than 1 µm are increasingly in the focus with respect to human health because of they are inhalable deeply into the human lung. A relevant part of such (ultra-)fine particles are light-absorbing particles. Important sources for such particles in the cities and residential areas are emissions from traffic (mainly soot), but also emissions from wood-burning stoves in private households. The relative contributions of these sources to the atmospheric particle load are important to know in order to be able to reduce hazardous emissions by specific measures.

The Royal Meteorological Institute of Belgium (RMI) gathers ambient aerosol data in Brussels with a 7-wavelengths aethalometer (mass concentration and absorption coefficient of light-absorbing aerosol). The measurement site is located in the sub-urban, rather residential southern part of Brussels and measurements are representative for the urban background. At the same site, the boundary layer height and atmospheric stability parameter are derived from a co-located ceilometer and eddy-covariance system. Further, RMI uses the multi-scale chemical transport model CHIMERE, coupled to the high resolution regional numerical weather prediction limited area model ALARO. In this context, CHIMERE will be used to evaluate emission scenarios.

The wavelength dependency of the measured aerosol parameters revealed distinct variations of aerosol composition, both on a daily, weekly, and seasonal scale. The Absorption Angstrom Exponent (AAE; spectral dependency of the absorption coefficient) revealed values around 1.3 during winter and around 1.0 during summer months. As fresh soot has a flat spectrum, (i.e., AAE around 1.0), higher AAE values during winter meant that other light-absorbing compounds, which absorb stronger in the UV, increased in importance (e.g., wood burning aerosol). The multi-wavelengths data is exploited to derive the relative contribution of fresh soot (thus traffic emissions) and other sources to the amount of light-absorbing aerosol. The influence of boundary layer height and atmospheric stability on the aerosol data will be presented.

**WEDNESDAY, 15 MAY** | EUROPASAAL

10:00 – 10:30

**Opening**

10:30 – 11:15

**Keynote Session A**

11:15 – 12:35

**Session B – UFP Sources**

**Lunch**  
FOYER/PATIO

13:35 – 14:20

**Keynote Session C**

14:20 – 15:40

**Session D – Ambient UFP Measurements**

**Coffee Break**  
FOYER

16:00 – 17:40

**Session E – Urban UFP**

17:40 – 19:30

**Poster Session F & Buffet**  
FOYER/PATIO

**THURSDAY, 16 MAY** | EUROPASAAL

09:00 – 09:45

**Keynote Session G**

09:45 – 10:30

**Keynote Session H**

**Coffee Break**  
FOYER

10:45 – 12:25

**Session I – UFP toxicity and epidemiology**

**Lunch**  
FOYER/PATIO

13:25 – 14:45

**Session J – Integrating actions and soot**

**Coffee Break**  
FOYER

15:00 – 16:30

**Panel discussion – Policy Follow up on  
Ultrafine Particle Regulation**

## Presentation

## Ultrafine Particles in Mexico City Metropolitan Area: a review

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### ABSTRACT

Mexico City Metropolitan Area (MCMA), once identified as the most polluted city in the world few decades ago is now a history of success in terms of air quality. As a result of a series of air quality actions implemented over the last 25 years, air quality has improved considerable. Based on a robust air monitoring and health databases, a recent study have shown that reductions in PM<sub>2.5</sub> in this period, avoided 22,500 premature deaths approximately. Still, there is more way to go since quality standards are not attained yet for ozone and particulate matter (PM<sub>2.5</sub> annual average concentrations in 2017 were 23 µg/m<sup>3</sup> and 30 µg/m<sup>3</sup>, in Mexico City and Metropolitan area monitoring sites, respectively). Existing data either from emissions inventories, continuous monitoring and field campaigns have shown the contribution of the different emissions sources, highlighting the important role of transportation in emissions and formation of ultrafine particles in MCMA. Few pilot studies have shown the high level of ultrafine particles emissions of the existing heavy duty diesel fleet (Euro II and III). In addition, results of ultrafine particles emissions of gasoline light vehicles measured at the inspection and maintenance test shown that old vehicles among other characteristics are also high emitters.

In despite of the above, ultrafine particles emissions and/or ambient concentrations are not yet part of the policy and/or regulation discussion in Mexico. The intention of this paper is to present a review of existing information of ultrafine particles in MCMA in order to analyze the impact of existing and planed control measures for air pollutants on ultrafine emissions and formation.

## Presentation

## New tools for assessing personal exposure near urban air pollution hotspots

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### ABSTRACT

During the last decade, researchers and policy makers have focused on the development and deployment of air pollution mitigation measures invoking solutions based on technology transfer. This term encompasses the synthesis of air quality monitoring, primarily by networks of inexpensive sensors, remote sensing and numerical modelling, as tools for supporting policy makers and disseminating air quality information to the citizens. It has been recognised that localised concentration maxima developing around traffic sources represent an exposure contribution of major epidemiological significance. The ability, therefore, of an integrated air quality management system to reliably assess personal exposure heavily depends on the consistent numerical treatment of multiscale interactions which determine the flow and dispersion structures in these fine spatial scales. Moreover, it is important to incorporate innovative methodologies for enhancing the stability and error-resilience of the sensor networks themselves. The approach presented in this work focuses on the utilisation of latest developments both in sensor technology and numerical air quality modelling, so as to provide end products able to support regulatory assessment and environmental information services. A peer-to-peer network of air quality measuring devices is deployed in six urban areas in the Balkan region in order to provide real time air quality data over areas of high population and emissions density. The coupled mesoscale modelling system MEMO/MARS-aero and the mesomicro MEMICO two-way coupling methodology implement the physical modelling core of the system in the respective spatial scales. These modelling tools are used to estimate, integrate and complement the sensor data on pollutant levels in predictions of high temporal and spatial resolution in order to highlight pollution hot spots. In the case of fine particulate matter, special adaptations are incorporated in the emissions and chemical transformation treatment in order to provide consistent number concentration fields, which constitute the most relevant exposure metric.

## Presentation

**Unlinking summer new particle formation and high ozone episodes**

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<sup>2</sup>Department of Civil and Environmental Engineering, Universitat Politècnica de Catalunya, Barcelona, 08034, Spain.

**ABSTRACT**

New particle formation (NPF) and ozone (O<sub>3</sub>) episodes are products of photochemically-driven processes. However, O<sub>3</sub> formation occurs under the presence of precursors (Monks et al., 2015), whereas NPF usually requires clean atmospheres (Boy and Kulmala, 2002). Clustering studies on particle number size distribution (PNSD) time series in high insolation urban areas revealed the frequent occurrence of photochemical NPF in spring and summer (Brines et al., 2015). Averaged O<sub>3</sub> concentrations reached the highest concentrations for the NPF-cluster in most of the studied cities. We intend here to elucidate if this simultaneous peaking of NPF and O<sub>3</sub> is due to the similar seasonal patterns of both pollutants or because NPF episodes coincide with high O<sub>3</sub> episodes. To this end we analyzed 2014-2018 spring and summer time series of PNSD and O<sub>3</sub> concentrations at Montseny, a regional background station 40 km NE of Barcelona (Spain) included in the ACTRIS and GAW networks. We categorized NPF events with the method proposed by (Dal Maso et al., 2005). K-means clustering was applied to the O<sub>3</sub> daily series. The number of clusters was chosen so that only one clusters contained all the days registering an exceedance of the information value (180 µg m<sup>-3</sup> h<sup>-1</sup>), using the minimum number of clusters. This was achieved by using 4 clusters. For each of them we studied the occurrence of NPF and the average daily cycles of other variables: PNSD, concentration of NO<sub>2</sub>, SO<sub>2</sub>, and PM<sub>10</sub>, and meteorological variables. The results suggest that, for spring and summer, the highest regional background UFPs concentrations coincide with the highest O<sub>3</sub> episodes, but the probability of NPF during these days is the lowest, even though the nucleation-mode number concentration is the highest. These days also present the maximum temperature, solar radiation, and wind speed, and the lowest relative humidity. The condensation sink and concentration of other pollutants are also the highest and peak simultaneously with the wind speed. This suggests that during these days pollutants are transported from the Barcelona metropolitan area to the regional background station. Conversely, when the plume does not reach the station, UFPs and O<sub>3</sub> concentrations are the lowest, and the probability of NPF is the highest.

**Acknowledgements**

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## Presentation

**Assessment of Personal Exposure to Particulate Emissions in Urban Microenvironments**

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**ABSTRACT**

The levels of fine (PM<sub>2.5</sub>), derived from combustion sources, in both outdoor and indoor environments within cities can be very high and are therefore of health concern. In recent years, the focus of several air pollution studies has shifted from PM<sub>2.5</sub> to other urban pollutants such as Black Carbon (BC) and ultrafine particles (UFP) due to their association with negative health effects. BC is a light-absorbing component of PM, and a good indicator of exposure to harmful particulate-bound chemical substances such as polycyclic aromatic hydrocarbons (PAHs) emitted from combustion sources such as urban vehicular traffic. UFP (those with aerodynamic diameter less than 0.1 µm) may be more toxic than PM<sub>2.5</sub> due to their enhanced pulmonary deposition efficiency and much higher surface area.

We assessed the personal exposure to PM<sub>2.5</sub>, UFPs and BC in diverse outdoor and indoor microenvironments (MEs) in Singapore. Since individuals are always on the move, it is important to follow their activity patterns, which determine their actual exposure. Consequently, a GPS was used to track individual's movement and exposure across MEs. Potential health risks associated with inhalation exposure to airborne particles were estimated. The findings obtained from the study can be useful for citizens to make informed choices to reduce their exposures to particulate pollution in both outdoor and indoor environments. In addition, the study outcomes provide a scientific basis for the government to implement effective mitigation measures to lower people's exposure to airborne particles at the city scale, contributing to improved urban air quality and enhanced health benefits.

## Poster

## MASS CONCENTRATIONS OF WATER-SOLUBLE IONS IN PM<sub>2.5</sub> PARTICLE FRACTION MEASURED AT URBAN BACKGROUND SITE IN CROATIA

Mirjana Čačković, Krešimir Šega, Vladimira Vađić, Gordana Peh nec, Valentina Gluščić and Ivan Bešlić

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**Keywords:** air pollution, sampling site, airborne particle, anion species, cation species

### ABSTRACT

Mass concentrations of PM<sub>2.5</sub> particle fraction, water-soluble anion species (Cl<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>) and cation species (Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, K<sup>+</sup>, Mg<sup>2+</sup>, Ca<sup>2+</sup>) were determined, to investigate the relationship between pollutant mass concentrations, contribution of measured species to PM<sub>2.5</sub> mass and prediction of the pollutant sources. Daily PM<sub>2.5</sub> samples were taken over three years 2014 – 2016 at urban background site (UBS) in northern part of Zagreb, Croatia.

Mass concentrations of PM<sub>2.5</sub> particle fraction were determined by gravimetry according to the standard HRN EN 14907:2006 (EN 14907:2005) and HRN EN 12341:2014 (EN 12341:2014).

Water-soluble ionic species were analysed using Thermo Scientific – ICS 5000 Capillary ion chromatography.

Annual average PM<sub>2.5</sub> mass concentration ranged from 19.6 µg m<sup>-3</sup> to 22.7 µg m<sup>-3</sup> respectively.

The annual average ion mass concentrations at UBS followed the order SO<sub>4</sub><sup>2-</sup> > NO<sub>3</sub><sup>-</sup> > NH<sub>4</sub><sup>+</sup> > K<sup>+</sup> > Ca<sup>2+</sup> > Cl<sup>-</sup> > Na<sup>+</sup> > Mg<sup>2+</sup>, respectively, contributed from 26.5% to 31.5% to the overall PM<sub>2.5</sub> mass, respectively. Annual average mass ratios of (NO<sub>3</sub><sup>-</sup>)/(SO<sub>4</sub><sup>2-</sup>) obtained in PM<sub>2.5</sub> ranged from 0.76 to 1.07, respectively, indicating that mobile source emission was an important contributor to particle mass at UBS.

The prediction of the pollutant sources, we ran the principal component analysis (PCA), which was performed using the STATISTICA 12.0 statistical packages. After varimax rotation, the obtained principal component factors were found to account for 95% of the variance. Factor loadings > 0.7 were considered significant.

## Poster

## Metal bioaccessibility and oxidative potential of PM<sub>2.5</sub> in Northern France

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**Keywords:** PM<sub>2.5</sub>; chemical characterization; metal bioaccessibility; Gamble's solution; oxidative potential; Ascorbic acid test; Dithiothreitol test.

### ABSTRACT

Atmospheric pollution is a cause of concern for human health, especially in urban and industrial zones. Previous studies focused on the measurement of total concentrations of PM components, without considering the bioaccessibility, especially of metal(loid)s, which can help to better understand the effect of PM uptake on human health [1]. Several toxicity mechanisms are related to an oxidative stress, and the measurement of the oxidative potential (OP) of PM<sub>2.5</sub> could be a first indicator of their toxic potential. In this work, PM<sub>2.5</sub> were collected using a Digital®, DA80 high volume sampler (30m<sup>3</sup>/h), during the period November 2010 to April 2011, in Dunkerque, an industrial coastal city located in Northern France, on semi-daily basis. The quantification of PM<sub>2.5</sub> major and trace elements, water soluble ions and total carbon was previously achieved using ICP-AES, ICP-MS, and Ion Chromatography respectively, as well as the source apportionment using non-negative matrix factorization [2]. In order to study the bioaccessibility of the PM<sub>2.5</sub> components, 55 selected filters were extracted using Gamble's solution, which mimics the interstitial fluid deep within the lungs, and the first physical interface encountered by inhaled materials. Extracts were then analyzed with ICP-MS, to determine the PM<sub>2.5</sub> bioaccessible metal content. PM<sub>2.5</sub> OP was assessed based on the capacity of the Gamble PM<sub>2.5</sub> extracts to oxidize the ascorbic acid (AA) and dithiothreitol (DTT) target molecules. AA is an antioxidant found in the respiratory tract lining fluids, and DTT is a strong reducing agent that simulates cellular reducing species in the biological systems [3]. OP-AA and OP-DTT values were compared, and the relationship between the PM<sub>2.5</sub> global composition, bioaccessible part and OP responses was also studied. Finally, the contribution of local and distant sources to the PM<sub>2.5</sub> OP characteristics was also investigated, considering local meteorological data and air-mass back trajectories.

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## Light absorbing properties of particles extracted from snow samples

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### ABSTRACT

Although BC is the dominating absorbing component in the atmosphere, there is evidence of numerous other aerosol components which are able to contribute to the aerosol light absorption. Such non-BC particles include mineral dust, volcanic ash, brown carbon as well as biological debris. Sooner or later different physical processes remove these airborne particles from the atmosphere and deposit them on the ground. If they are deposited on snow or ice surfaces these particles might induce melting processes by the absorption of solar radiation. Because snow is the most reflective natural surface on earth, already small amounts of absorptive impurities can significantly reduce the surface albedo.

The contribution of the albedo reduction on the radiative balance of the atmosphere is usually assessed based on the mass concentration of refractory BC deposited in the snow. Ignoring the absorption contribution of the non-BC aerosol components might result in an underestimation of the albedo reduction. Therefore, the knowledge of the visible absorption coefficients of aerosol particles deposited in snow and ice, is essential for a realistic evaluation of the albedo effect on regional and global climate.

To specify the absorbing properties of particles trapped in snow samples, we combined photoacoustic absorption spectroscopy with single particle black carbon mass analysis using a Single Particle Soot Photometer (SP2). In this way, the aerosol absorption coefficients in the visible spectral range and the refractory black carbon mass could be simultaneously derived. This type of analysis is quite challenging because of the low particle mass concentrations typically present in natural snow samples. In a first case study we used a set of snow samples from the Environmental Research Station (UFS) Zugspitze. Our results show significantly enhanced light absorption of the particles released from the snow samples compared to the particle absorption that can be linked to the refractory black carbon mass in the snow. Further analyses revealed a substantial portion of biological material within the snow that could be cause for the observed additional aerosol absorption.

## NANOPARTICLE RELEASE FROM THERMAL DECOMPOSITION OF POLYMER NANOCOMPOSITES AND THE BIOLOGICAL POTENTIAL OF THE EMISSIONS

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### ABSTRACT

Adding nanoparticles to polymers improves the properties significantly, such as UV resistance or even electrical conductivity. The growing use of these composite materials leads to a higher amount in disposals eventually. Within the circular economy there are two ways of handling: the recycling by shredding and reuse and the thermal treatment by combustion in municipal waste incinerators. In both cases there is nearly no information about the behavior of the nanoparticles and possible release scenarios. In this study a laboratory burner is used as a flexible set up to incinerate the polymer nanocomposites. The flue gas containing a complex mixture of combustion gases and particles is characterized by different particle analysers, PAH analysis, VOC analysis and TEM. The biological impact is studied by using a VITROCELL Automated ALI exposure station. Hereby, cells of the adenocarcinoma cell line A549 as well as a reconstituted bronchial epithelium (MucilAir, Epithelix) were exposed for 4 hours to the aerosols emitted from the combustion process. Within the exposure process, cells were exposed to the native aerosol, an aerosol under conditions to increase particle deposition via high voltage as well as a filtered aerosol, and therefore the sole gaseous phase. Furthermore, each exposure included a so-called clean air control, where cells were exposed to filtered air. The exposure was followed by a 21 h post-incubation before the cytotoxic effects were determined via LDH-release. To reveal if possible adverse effects are caused by the used nano-scaled filling material, all used nanomaterials did also undergo the same combustion process as a single material. Cytotoxicity studies showed no increased cytotoxic effects after the combustion of the sole nano-scaled filling materials. However, combustion of PE containing materials resulted in an enhanced LDH-release, and therefore cytotoxicity, in both cell culture models. Since no difference between exposures of unfiltered and filtered aerosols was apparent, it suggested that the observed cytotoxicity is due to the combustion induced gaseous phase.

## Poster

## NOVEL METHOD TO ANALYSE ULTRAFINE PARTICLES USING AN ARTIFICIAL INTELLIGENCE APPROACH

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**Keyword:** Stochastic Boosted Regression Trees (BRT), Algorithm, atmospheric environment data, variable interactions

### ABSTRACT

This presentation will discuss the used of an artificial intelligent method namely the 'stochastic boosted regression trees' (BRT) approach that uses an algorithm that applied to an air pollution data namely particle number count concentrations ([PNC]), an ultrafine particles data and particulate matter data case study in United Kingdom and Malaysia. The development of the BRT model involves determining the model algorithm settings of the main model input parameters (learning rate, number of trees and interaction depth) that were tested using the R software (version 3.02) by choosing a 10-fold cross-validation approach with combination of  $lr$  0.05 and  $tc$  5 of training set for BRT models. It was found, that the coefficient of determination ( $R^2$ ) value for the BRT best iteration models were above 0.60 for [PNC] in urban environment. The fine and course particle number (FPNC and CPNC) were found to be 0.75 and 0.72 respectively for one of coastal dataset while  $R^2$  value of 0.78 and 0.85 were obtained for Malaysia data. Further investigated were performed to rank factor influenced. It was found, that Carbon monoxide (30.28 %) gas and followed by temperature (16.81%) and wind direction (16.4%) were found the high factor influenced PM10 in urban environment. The interaction index (H-index) between parameters to concentration of pollutants were also examined graphically and in numerical form (H-Index). It was found that the H-Index between parameters 0.3 to 0.4 indicated that the BRT technique able to explain the science of air pollution. The consistent results to produce the best model from the best iteration, able to rank the best parameters that influence most to the concentration of predictor and able to predict interaction between variables premise BRT as one of the method or tools to analyse air pollution data.

## Poster

## Use of new measurement device to build a high-resolution network in Augsburg city – Smart Air Quality Network-Project

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### ABSTRACT

In traditional approach, the air quality in urban environment is monitored by relatively few measuring stations using stationary measuring technology. However, the spatial distribution of air pollutants in cities is very inhomogeneous and depends on various factors. The Smart Air Quality Network project (SAQN) is aimed to set up a dense network of sensor devices for particle mass and number concentration in the city of Augsburg (Germany) as well as conducting of intensive mobile measurements including walking and bike measurements. The main target is to generate real-time data that can be used for several actions and measures in order to reduce pollution levels as well as to inform people about the current levels of air pollutants. Furthermore, the data will be also used for the development and validation of dispersion and land use regression models.

For the purpose of this project, a novel measuring device is being developed by GRIMM Aerosol company, so-called "scientific scouts" (autonomous, mobile smart dust measurement devices that are auto-calibrated to a high-quality reference instrument within an intelligent monitoring network). In Phase 1 we already installed 15 scientific scouts at different sampling sites within the Augsburg city. The sampling sites are located in different environments: close to traffic and traffic hotspots, near combustion sources, in the city center and in urban background. In Phase II of this project 35 updated scientific scouts will be installed until summer 2019. The scientific scouts will be able to measure particle mass and number concentrations.

The preliminary results suggest good performance of the scientific scouts and their applicability for the purpose of SAQN project. Ongoing calibration will help to improve the performance and efficiency of the low-cost devices. On the other hand, the planned extension of the network in the following months will provide necessary data for the modelling approach.

This project is supported by Deutsches Bundesministerium für Verkehr und digitale Infrastruktur (FKZ 19F2003).

## Poster

## Personal Exposure of Urban Traffic Policemen to benzene in the city of Klang Valley: Health Risk Prediction and Chromosomal Damage

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**Keywords:** Benzene, health risk prediction, chromosomal damage, urban traffic policemen, Klang Valley

### ABSTRACT

**Introduction:** In the ambient atmosphere, benzene is ubiquitously emitted from the vehicle exhausts and several anthropogenic sources. A public health concern over benzene exposure at the ambient level has risen as it was recognized in Class 1 carcinogenic compound. Leukemogenic risk of benzene is well-established, therefore World Health Organization has stated no specific threshold value has been advocated for its presence in the ambient air.

**Methods:** Personal exposure to benzene and the health risk prediction and chromosomal damage among urban traffic policemen and office workers (as the comparative group) were assessed. The study aims to ascertain benzene concentration and its health risk impact as well as to investigate the early cancer risk indicator by evaluating the chromosomal damage via micronuclei (MN) assay. Results: The mean personal exposure level to benzene in 49 urban traffic policemen was  $27.74 \pm 17.56 \mu\text{g}/\text{m}^3$  compared to only  $7.29 \pm 3.30 \mu\text{g}/\text{m}^3$  in 51 office workers for 8 h-Time-Weighted Average (TWA). Both groups showed cancer risk (CR) value greater than acceptable level of  $1 \times 10^{-6}$  with case of urban traffic policemen ( $1.8 \times 10^{-5}$ ) higher than office workers ( $5.6 \times 10^{-6}$ ). Hazard quotient in both groups considered safe despite HQ for urban traffic policemen almost to the value of 1. A significantly higher MN frequency (per 1000 cells) was reported in urban traffic policemen than those in the comparative group with  $p < 0.001$ . Conclusion: The carcinogenicity of benzene might induce the chromosomal damage among urban traffic policemen due to direct exposure from vehicular emissions during they were controlling the traffic flows at rush hours.

## Presentation

## Keeping science in UFP policy making – lessons learned from “fake news” spread by (a few) German mass media

Prof. Nino Künzli, MD PhD

Deputy Director Swiss Tropical and Public Health Institute (Swiss TPH), Basel, and Dean of the Swiss School of Public Health (SSPH+), Switzerland.

Professor for Public Health University of Basel

President of the Federal Commission on Air Hygiene (advisory board of the Swiss Government)

### ABSTRACT

Since the unopposed featuring of a retired German lung physician as “expert in air pollution and health” by a German TV station, German language mass media have seen an unprecedented hype. It crossed the borders to even reach the E.U. parliament. The physician - not a scientist - claimed that the WHO Air Quality Guidelines lack scientific evidence and that the air quality standards for NO<sub>2</sub> and PM should be eliminated. His statement made to the German Society of Lung Physicians” was signed by 130 colleagues. Despite a solid science with more than 35’000 research articles on “[air pollution] AND [health]” published by >77’000 authors (none by the lung physician nor his signees), the hype entertained media discussions for weeks and months. Though the political background of the celebration of “fake news” is based on the policy aftermath of the diesel engine manipulation scandals, it is worth reviewing its broader context of 30 years of local, national, and international clean air policy making. The presentation puts the health science in perspective of policy decisions where public health science goals compete with vested interests and the side-tracking maneuvers of selective court decisions. Some lessons learned from the waves of “alternative facts” will be relevant in the development and decisions related to future regulations of combustion-related ultra-fine particulate matter.

## Presentation

## Thinking outside the box: how to use the existing science on ultrafine particles to protect against them?

Prof. Lidia Morawska  
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### ABSTRACT

Over the past two decades numerous research projects have investigated an array of characteristics of ultrafine particles (UFP), or more generally, particles of the lower submicrometre size range. There is a reasonably good scientific understanding of the particle concentration levels, modality of size distributions associated with various sources, and their spatial heterogeneity in the urban environments. However, despite the progress made, there has only been very limited progress in understanding the risk to human health posed by UFP, and therefore whether the particles should be controlled. Part of the reason relates to the challenges in conducting epidemiological studies on the impact of UFP, and lack of consistency between the outcomes of some of the studies. In 2018 a group of exposure experts, toxicologist and epidemiologist joint forces to think outside the box, and to use the wealth of scientific knowledge on UFP physico-chemistry, toxicology and epidemiology to develop an approach that will create the basis for protection against the particles. The group has been working on developing a White Paper to inform decision makers on the state of knowledge on UFP and on conducting meta-analysis of data from epidemiologic studies to identify any evidence that can already be used to recommend exposure limits for UFP. The outcome of this work will contribute to the current debates on UFP, and to the work conducted on this topic by national and international bodies, including the World Health Organization or the European Union. The presentation will summarize the progress of this work and the picture that begins to emerge.

## Presentation

## Fine and ultrafine particles from indoor sources – Effects on healthy humans in a controlled exposure study and on lung epithelial cells in vitro.

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### ABSTRACT

In recent years increasing concern has been expressed about the potential adverse health effects of particles from indoor sources. The aims of the EPIA project were: (1) to characterize potentially relevant indoor sources of (ultra)fine particles with respect to their emission levels and composition and (2) to investigate their adverse health effects. We investigated the effects of emissions from candle burning (CB), toasting of bread (TB) and sausage frying (FS) in a randomized, cross-over sham-controlled exposure study in healthy adults as well as in vitro in A549 human lung epithelial cells. Participants were exposed for 2 h to each of these sources at two different exposure levels, and examined before, during and after the exposures at defined time-intervals. We found transient associations between exposures and several respiratory and cardiovascular effects as well as inflammatory changes (e.g. lung function, blood pressure, arterial stiffness, interleukin-8 in nasal lavage/blood). Specific effects were found to depend strongly on the emission source and the selected exposure metric (e.g. size-specific particle mass concentration, size-specific particle number concentration, lung deposited surface area concentration). Evaluation of PM<sub>2.5</sub> samples in the A549 cells, revealed an increased interleukin-8 release and DNA strand breakage induction for toasting, whereas candle burning only resulted in DNA damage. The results from our project demonstrate that elevated concentrations from certain indoor emission sources may lead to changes in the lung and cardiovascular systems as well as possibly induce inflammation. The study was supported by the Federal Environment Agency (UBA, FKZ3711-62-205).

## Presentation

## Chemical characterization and in vitro toxicity on human bronchial epithelial cells BEAS-2B of PM<sub>2.5</sub> from an urban site under industrial emission influence

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**Keywords:** Fine and ultrafine particles, chemical composition, BEAS-2B cells, cytotoxicity, biotransformation, genotoxicity

### ABSTRACT

Particulate Matter (PM) is one of the most relevant environment-related health issues all over the world. In 2013, the International Agency for Research on Cancer (IARC) has classified air pollution and PM as a carcinogen for humans [1]. However, the mechanisms involved in the toxicity of these particles remains poorly understood, mainly because PM are uniquely complex owing to their physicochemical characteristics. In this study, fine particles were collected in the city center of Dunkirk, northern France using a 5 stages high volume cascade impactor (Staplex® 235, 68m<sup>3</sup>/h) and a Digital DA80 high volume sampler (30m<sup>3</sup>/h). Samples were extensively characterized for their physico-chemical properties, including trace metals, water-soluble ions and organic species. Normal human bronchial epithelial cells (BEAS-2B) were used as cell model for toxicological analysis. Cytotoxicity, PAHs-metabolizing enzymes gene expression and genotoxic alterations were evaluated after 24, 48 or 72 h of exposure considering increasing concentrations of PM<sub>2.5-0.3</sub>, organic extracts (OE) and water-soluble fraction (WF) of PM<sub>2.5-0.3</sub> and PM<sub>2.5</sub>. Several sources such as road traffic, industrial activities mainly related to steelmaking, marine emissions including sea-salts and shipping, as well as soil resuspension were found to contribute to the PM<sub>2.5</sub> composition. Cytotoxicity assessment results showed time and dose dependent responses, with effects mainly related to PAH compounds in PM<sub>2.5</sub> OE in which their content were 12 times higher than in PM<sub>2.5-0.3</sub> one [2]. Differences in the induction of CYP1A1, CYP1B1 and NQO1 genes expression involved in the metabolic activation of organic compounds, as well as genotoxic effects (oxidative DNA adducts, H2A.X phosphorylation) were also evidenced after cells exposure to OE and PM<sub>2.5-0.3</sub> [3]. These results confirm the major effect of organic compounds on toxic effects, but also the potential contribution of the inorganic fraction of the PM which maintains longer the effects in exposed cells.

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## Presentation

### Toxicity of quasi-ultrafine and fine particles: focus on the effects of PM<sub>2.5</sub> organic extractable and non-extractable matter fractions

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**Keywords:** fine particles, quasi-ultrafine particles, organic extractable matter, metabolic activation, genotoxicity.

#### ABSTRACT

Air pollution represents today one of the major risk factors for human health. An important part of this threat is due to the presence in the atmosphere of fine particulate matter (PM<sub>2.5</sub>). PM<sub>2.5</sub> forms a heterogeneous mixture of inorganic pollutants (metals, ions...), organic pollutants (volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAHs), dioxins, polychlorobiphenyls (PCBs)...), and biological contaminants (pollen, bacteria, fungi...). To date many studies have demonstrated the toxicity of PAHs and some metals, but so far, no study has been able to clearly attribute the toxicological effects observed to a class of pollutants. Therefore, this study aims to determine the physicochemical characteristics of PM<sub>2.5-0.3</sub> and PM<sub>0.3</sub> and to compare the toxicity of native PM<sub>2.5-0.3</sub>, organic fractions of fine (EOM<sub>2.5-0.3</sub>) and quasi ultrafine particles (OEM<sub>0.3</sub>), and PM<sub>2.5-0.3</sub> freed from this organic fraction (dPM<sub>2.5-0.3</sub>) on BEAS-2B cells in culture. Fine and quasi-ultrafine particles were sampled in the southern suburb of Beirut, Lebanon. Chemical characterization showed that quasi-ultrafine particles were about 40 times more concentrated in PAHs than fines one suggesting a significant influence of anthropogenic activities and combustion sources (industries, road traffic and electric generators) on the emission of quasi-ultrafine particles. The influence of combustion sources was confirmed by investigation of PAHs diagnostic ratios. In addition, BEAS-2B cells exposed to PM<sub>2.5-0.3</sub>, dPM<sub>2.5-0.3</sub>, EOM<sub>2.5-0.3</sub> and OEM<sub>0.3</sub> lead to different results concerning metabolic activation of PAHs pathway and proteins expression of biomarkers implicated in the pathway of genotoxicity. Globally, OEM<sub>0.3</sub> was the most inducer for phase I and phase II enzymes implicated in the metabolic activation of PAHs (AhR, AhRR, ARNT, Cyp1A1, Cyp1B1, EPHX-1, GSTA-4) and OEM<sub>0.3</sub> induced DNA damage, felt by ATR and followed by a cascade of protein phosphorylations contributing to the cell cycle arrest (P21 and P53 induction).

## Presentation

### TESTING OF AEROSOLS FOR LUNG TOXICITY BY IN-VITRO STUDIES AT THE AIR-LIQUID INTERFACE FOR UP TO 24 HOURS

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#### ABSTRACT

The state of the art of studying the health effects of aerosols in vitro is based on submerged exposure of collected particulate matter, suspended in culture medium. However, this method neglects the gas phase including their interactions with particles and cells. It may change the properties of the investigated particles and does not represent the actual process in the human lung.

Exposure at the Air-Liquid Interface (ALI) avoids these disadvantages, but requires a comprehensive system to guarantee reproducible conditions. Therefore, KIT and VITROCELL Systems developed a fully automated ALI exposure station. The exposure station offers a complete measurement system for parallel exposure of up to 24 human lung cell cultures towards gases, nanoparticles and complex mixtures such as combustion aerosols. The aerosol flow, temperature, and humidity are adjusted to the conditions resembling the human lung. An internal negative control using humidified synthetic air is also implemented and the particle dose per time can be increased by electrostatic particle deposition. The particle mass per area deposited by diffusional as well as by electrostatic mechanism is monitored online using a quartz crystal microbalance. Additionally, a new tool to reproducibly expose sample grids for transmission electron microscopy was developed and applied. Image evaluation of TEM images delivers dose information with respect to the spatial distribution and the agglomeration state of the deposited particles. Applications of the ALI exposure station are environmental atmospheres and technical emission sources like marine diesel engines or wood combustion.

Long-term stability of A549 lung cells was examined for exposure times up to 24 hours by exposing A549 cell cultures towards clean air as well as towards airborne titanium dioxide and copper oxide nanoparticles. Dose measurement data and biological responses as viability (AlamarBlue assay), cytotoxicity (LDH release), and release of cytokines during long-term exposure are reported.

## Presentation

## Long-term exposure to ultrafine particles and incidence of cardiovascular and cerebrovascular disease in the EPIC-NL cohort

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 †: These authors co-supervised this work

### ABSTRACT

**Background:** There is a small but growing evidence base that exposure to ultrafine particles (UFP – particles smaller than 100nm) may play an important role in the etiology of several illnesses, including cardiovascular disease (CVD). However, this has been under-explored in population-level studies.

**Methods:** Using Cox proportional hazard models we studied the association between long-term exposure to UFP (predicted via recently developed land use regression models) and incident cardiovascular disease in the Dutch arm of the European Prospective Investigation into Cancer cohort (EPIC-NL), which contains 33,831 Dutch residents. Hazard ratios (HR) for UFP were compared to HRs for more routinely monitored air pollutants, including PM<sub>10</sub>, PM<sub>coarse</sub>, PM<sub>2.5</sub>, PM<sub>2.5</sub> absorbance, NO<sub>x</sub>, and NO<sub>2</sub>. Joint-pollutant effects were also evaluated in two-pollutant models.

**Results:** Long-term exposure to UFP was associated with increased HRs for all incident cardiovascular disease (HR = 1.18 per 10,000 particles/cm<sup>3</sup>, 95% CI: 1.03, 1.34), myocardial infarction (HR = 1.34, 95% CI: 1.00, 1.79), and heart failure (HR = 1.76, 95% CI: 1.17, 2.66). Positive associations were also observed for NO<sub>2</sub> (HR for heart failure = 1.22, 95% CI: 1.01, 1.48 per 20 µg/m<sup>3</sup>) and coarse PM (HR for all CVD = 1.21, 95% CI: 1.01, 1.45 per 10 µg/m<sup>3</sup>). CVD was not positively associated with PM<sub>2.5</sub> (HR for all CVD = 0.95, 95% CI: 0.75, 1.28 per 5 µg/m<sup>3</sup>). HRs for UFP and cerebrovascular diseases were positive, but not significant. In two-pollutant models (UFP + NO<sub>2</sub> and UFP + PMcoarse), positive associations tended to remain for UFP, while HRs for PMcoarse and NO<sub>2</sub> generally attenuated towards the null.

**Conclusions:** These findings strengthen the overall evidence that UFP exposure plays an important role in cardiovascular health and that risks of ambient air pollution, based on conventional air pollution metrics, may underestimate the true population risk. ment data and biological responses as viability (AlamarBlue assay), cytotoxicity (LDH release), and release of cytokines during long-term exposure are reported.

## Presentation

## Investigation of UFP-Distributions with Stationary and Mobile Measurements at the Düsseldorf Airport

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### ABSTRACT

Due to human activities a variety of different air pollutants are released into the air. Significant sources of emissions are industry, energy sector and traffic. The traffic sector has different emission sources and is not only related to road traffic. However, while there are many studies that describe the air pollution caused by road traffic, there are only a few studies which describe the emissions released by airports. The Laboratory for Environmental Measurement Techniques of the Düsseldorf University of Applied Sciences performed a case-study to investigate the amount of emissions generated by airport activities. The campaign was carried out during October 2018 for the Environmental State Agency of North-Rhine-Westphalia (LANUV). The aim was to investigate the temporal and the spatial variation of emissions released by the Düsseldorf Airport with a main focus on the release of ultrafine particles (UFP). Therefore, we used a combined strategy in form of stationary and mobile measurements. Additional to the ground-based measurements, a research-aircraft flight was performed in order to investigate the downwind UFP-plume of the airport. Two measurement stations were positioned at the north and south border of the airport to measure the temporal variation of the particle number concentration. These stations were equipped with an SMPS (TSI NanoScan) and a discMini (testo). Additionally, in order to investigate the spatial distribution in the surrounding areas an e-bike was equipped with a discMini (testo), miniWRAS (Grimm/Durag), aethalometer (Aethlabs), cavity-DOAS (IUP Heidelberg), windsonic (Gill instruments), GPS device and a camera. With this e-bike predefined routes were cycled, starting with a full round along the border of the airport. Depending on the actual wind direction, the second part of the route covered areas that were located downwind to the airport. The first results show that the amount of emissions from the airport for species like nitrogen dioxide, soot and coarse particles are on a moderate level. In contrast to that, the amount of ultrafine particles released by the airport resulted in greatly increased values. The data show a typical trend of UFP concentrations, which is characterized by an immediate increase in parallel to the beginning of air traffic in the morning hours, a stay on a high level during the day and a decrease to a typical background concentration level in the late evening, when the air traffic stops due to night flight ban at the Düsseldorf Airport. The wind has a strong influence on the spread of the emissions, so that significantly increased UFP concentrations could be measured up to several kilometers away downwind to the airport. The results of this study indicate that the main part of the UFP emissions is released by the jet engines of the aircraft and the amount of the UFP emissions correlates with the frequency of air traffic.

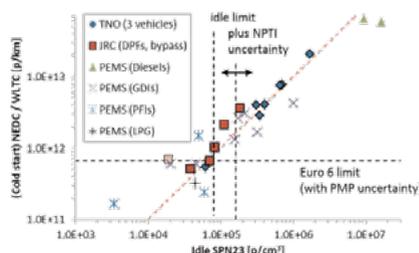
## Presentation

## New Periodical Technical Inspection (N-PTI) for LDV and HDV to guarantee emission quality

A.Mayer, V.Hensel, Th.Lutz / VERT-Association, Switzerland

### ABSTRACT

Periodic Technical Inspection of emission quality PTI was abandoned by most EU member states in 2014 following the EU-Directive 2014/45 which recommended to delegate emission quality to OBD. After Dieselgate this naïve dream was over and VERT proposed during the German Dieselgate Hearing Sept.2016 to re-introduce PTI for all vehicles with emission control by DPF and SCR. With the introduction of particulate filters on diesel as well as GDI engines, the measurement of particulate emissions during PTI or road-side checks however, became a nontrivial task. Opacity and smoke meters do not have sufficient sensitivity to identify particulate filter failures or tampering on new, low emission internal combustion engines. Recent studies conducted in the Netherlands, Switzerland and Belgium have shown that about 10% of passenger cars equipped with DPF have high PN emissions that could indicate a damaged or removed DPF. To address this problem, the VERT Association launched a New Periodical Technical Inspection (N-PTI) initiative to develop a simple, robust and tamper-proof method for checking the functionality of DPFs using particle number (PN) instruments. The N-PTI initiative, launched in November 2016, is supported by the European Union as well as the governments of Germany, the Netherlands, Belgium, and Switzerland. The proposed test is conducted at idle using a PN instrument. It is assumed that the process will be suitable with minor, if any, modifications for petrol engines. The test protocol is also appropriate for road-side inspections, such as by the police. The first results are promising. Instruments in their prototype stage are already capable of recognizing vehicles that have been manipulated using partial bypass that resulted in PN emissions close to maximum allowed type approval levels (i.e.,  $6 \times 10^{11}$  1/km) and present a satisfactory correlation with PEMS compliant instrumentation. Work on the testing procedure and pass/fail limit is still ongoing. This work is also under the evaluation of the CITA (International Motor Vehicle Inspection Committee) Roadworthiness Technical Working Group which focuses on tampering with exhaust emission control systems.



Emission factor (#/km) during NEDC or WLTC vs raw exhaust concentration (#/cm<sup>3</sup>) measured by JRC during low idle with different prototype or PEMS instruments

The results show a good correlation between emission levels during the type approval cycle (NEDC/WLTC) and low idle emissions even with first generation N-PTI instruments. These results suggest that the technical specifications of NPTI instruments should have acceptable uncertainty, with low cost. The Netherlands and Germany have already started programs that will lead to the adoption of mandatory N-PTI emission testing requirements. NMI, the Dutch metrology institute, has released a draft International Recommendation with the specifications of the PTI particulate number counter. The N-PTI DPF test may become available in the Netherlands at RDW test stations as soon as 2019, while the nationwide target date for the introduction of N-PTI testing is 2021. In Germany, the Federal Council passed a law in September 2017 (published in the German StVZO 2017) that re-introduces PTI first by smoke measurement but PN measurements at idle are to be required from 2021.

## Presentation

## Externalities and opportunities – impact of new transport & heating solutions on air quality in our cities

Marcin Lewenstein

InnoEnergy Innovation Officer, Energy for Circular Economy Thematic Field Leader

**Keywords:** innovation, funding, energy, transport, heating, air pollution, smog

### ABSTRACT

As a fund, InnoEnergy aims to simplify and shorten the journey from lab to launch. We focus on developing and investing in innovative and commercially viable products and solutions, and we finance multi-skilled partnerships that significantly reduce the risks of product development. We provide researchers and inventors with access to a deep pool of complementary skills and resources, and connect them to markets and commercial opportunities across Europe. Our collaborative model encourages businesses of all sizes to participate in innovative partnerships, consider new ideas and support new research from across Europe.

Recently, we have finalized a broad study into the impact of energy innovation, novel business models and policy enablers on the reduction of smog and other forms of air pollution linked to urban energy consumption. The Clean Air Challenge report has been drafted in response to the European Commission's recent assertion that smog may account for as many as 1 in every 10 premature deaths in the world, and will cost the EU an astonishing €475 billion per year between 2018 and 2025. That represents 2.9 per cent of average annual GDP. Our study outlines what can be achieved within the air quality domain through boosting the penetration of economically viable, novel technologies and solutions for transportation and heating, indicating that smog reduction through the adoption of innovative solutions could save European citizens €183 billion by 2025.

In coming years solutions for tackling air pollution will be one of the key focus points of InnoEnergy investment policy.

## Presentation

**UFP-Integrating action for cleaner air and climate protection**

Andrzej Jagusiewicz, EFCA President, Poland

John Murlis, EFCA Deputy President, UK

**ABSTRACT**

The background information related to health effects and damage caused to ecosystems by PM atmospheric pollution, particularly by its fine fraction, will be summarised. Current international policy instruments for reducing airborne emissions and, consequently, improving air quality, will be reviewed. In particular the EU clean air package and the UN/ECE initiatives under the Long-Range Transboundary Air Pollution Convention (LRTAP), including the recently adopted Long-term Strategy, will be considered.

The air policy initiatives by EFCA related to improve air quality in relation to PM and its ultrafine fraction/Black Carbon will be described and assessed.

Combustion of all kinds produces PM pollution, including its ultrafine fraction (UFP). Carbonaceous particles in form of Black Carbon (BC) and Organic Aerosols (OA) are of particular concern. UFPs are also formed as secondary pollutants. The latter have substantial influence on particle formation and their growth generates half of the cloud condensation nuclei in the atmosphere. Non-CO<sub>2</sub> Greenhouse Gases (NCGG), however, are underestimated as pollutants by the climate policy community and deserve to be treated as equally important. UFPs play an important role in policy to reduce toxic air pollution and climate forcers.

The series of UFP Symposia has provided strong evidence of impact, and information on sources and effective control techniques. EFCA therefore believes it is now timely to consider policy aspect. It fully supports UFP/BC regulation, including new ceilings in the EU NEC Directive and the revised Gothenburg Protocol under the LRTAP. Moreover, a new metric is urgently needed for UFPs, expressed in weight and by number of particles. Also, dual policy, integrating cleaner air and climate protection criteria, to combat UFPs can be more effective and generate co-benefits for both.

The role of integrated policy, as opposed to the current practice of separate sectoral policies in combatting air pollution will be considered with reference to concrete examples, including from the energy system.







## HOST ORGANIZATIONS



### **KIT | Karlsruhe Institute of Technology**

Karlsruhe Institute of Technology (KIT) pools its three core tasks of research, higher education, and innovation in a mission. The KIT Climate and Environment Center develops strategies and technologies to secure the natural bases of life.

**[www.kit.edu](http://www.kit.edu)**



**EFCA | The European Federation of Clean Air and Environmental Protection Associations** aims at encouraging professional activity in Europe while working at the interface between science and (European) policy on environmental problems.

**[www.efca.net](http://www.efca.net)**



**GUS | Gesellschaft für Umweltsimulation e.V.** (Society for Environmental Engineering). It is the organization of people, institutions and companies who work in environmental engineering and testing. Since 1969, GUS supports the development of environmental engineering on a non profit basis.

**[www.gus-ev.de](http://www.gus-ev.de)**



### **CEEES | The Confederation of European Environmental Engineering Societies**

is the umbrella organisation of national technical societies for environmental engineering and testing. CEEES promotes technical advisory boards, seminars and conferences with the support of national member societies.

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