Monitoring Ambient Air 2011

Towards the 2013 Revision of the Ambient Air Quality Directive - Issues and Solutions

**Conference with
Posters and Exhibition**

**Organised by the
Automation and Analytical Management Group -
Royal Society of Chemistry**

Monday 12th and Tuesday 13th December 2011

At The Royal Society of Chemistry,
Burlington House, Piccadilly,
London W1J 0BA

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Towards the 2013 Revision of the Ambient Air Quality Directive - Issues and Solutions

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Monday 12th and Tuesday 13th December 2011
at The Royal Society of Chemistry, Burlington House, London

Day 1 - Monday, 12th December 2011

10:00   Registration

Session 1:   Some European Perspectives

Chairperson: **Peter Woods**, National Physical Laboratory, UK

10:30   Air Quality Across Europe, Progress Towards Limit Value Attainment
        And Outstanding Issues
        Daniela Buzica-Widlowski
        DG Environment, Belgium

11:00   Meeting the EU Limit Values in the UK
        Tim Williamson
        DEFRA, UK

11:30   Trends in NO_2 and PM_{10} Concentration in the Netherlands
        Ronald Hoogerbrugge
        RIVM, Netherlands

12:00   The Past Present and Future of Metals and PAH Monitoring in the UK
        Richard Brown
        National Physical Laboratory, UK

12:30   Towards an Improved Harmonization of Regional Scale Air Quality
        Monitoring in Europe - The Role of EMEP in Providing Information
        To support Future EU Directives
        Kjetil Tørseth
        Norwegian Institute for Air Research, Norway

13:00 Lunch - Exhibition & Posters

Session 2:   The Carbon Content of Particulate Matter

Chairperson: **Theo Hafkenscheid**, RIVM, Netherlands

14:00   Intercomparisons of Carbonaceous Aerosol Source Apportionment
        Models at Various Urban Sites
        Olivier Favez
        INERIS, France

14:30 Reduction of Black Carbon and CO_2 in Urban Environments
Jim Mills
Air Monitors Ltd, UK

15:00 Carbonaceous Aerosol Measurements at an Urban Area in the
PO Valley - Italy
Mihaela Mircea
ENEA, Italy

15:30 Tea / Coffee - Exhibition & Posters

16:00 Optical Detection and Discremination Between Biomass and Fossil Fuel
Combustion: Influence on Air Quality in Different Environments
Grisa Močnik
Aerosol d.o.o., Slovenia

16:30 Air Quality Monitoring of Black Elemental and Organic Carbon in Flanders
Christine Matheeussen
Flemish Environment Agency, Belgium

17:00 Intercomparison of Thermal-Optical Protocols Currently Used in France and
Europe for the Assessment of Ambient Air Organic and Elemental Carbon
Within PM
Laura Chiappini
INERIS, France

17:30 End of Day One

Day 2 - Tuesday, 13th December 2011

09:30 Tea / Coffee - Exhibition and Posters

Session 3: Current and Future Air Pollution Monitoring - AirMonTech Project Update

Chairperson: **Thomas Kuhlbusch**, IUTA e.V, Germany

10:00 The European Commission's Expectations from the AirMonTech Project
Michel Schouppe
EU Commission, Belgium

10:30 The AirMonTech Database
Annette Borowiak
JRC - EC, Italy

11:00 Existing Technologies for Regulated Metrics
Christophe Hueglin
EMPA, Switzerland

11:30   New Monitoring Technologies, New Metrics and Proxies
        Ulrich Quass
        IUTA e.V, Germany

Session 4:   NO$_2$ Sensors and Climate Change

Chairperson: **Gary Fuller**, King's College London, UK

12:00   Baseline and Low Emission Zone Scenario Modelling to Support the
        Development of UK Air Quality Plans for NO$_2$ Compliance
        John Stedman
        AEAT, UK

12:30 Lunch - Exhibition & Posters

13:30   Recent Evidence and Future Prospects Relating to NO$_x$ and NO$_2$ From
        Road Vehicles
        David Carslaw
        King's College London, UK

14:00   Nitrogen Dioxide Measurement Ambient Concentrations and Future
        Control Measures
        Samuel Rouse
        Brighton & Hove City Council, UK

14:30   Low-Cost Sensor Networks for Measuring Urban Air Quality
        Rod Jones
        Cambridge University, UK

15:00   Key Findings from the UNEP Report on Integrated Assessment of Black
        Carbon and Tropospheric Ozone
        Elisabetta Vignati
        JRC - EC, Italy

15:30   From Air Quality to Climate Change - A Switcher's Perspective
        Richard Gilham
        Met Office Hadley Centre, UK

16:00 End of Presentations - Tea / Coffee

16:30 End of Conference

ABSTRACTS

Air Quality Across Europe, Progress Towards Limit Value Attainment And Outstanding Issues

Daniela Buzica-Widlowski
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ABSTRACT

As a result of EU legislation, much progress has been made in tackling air pollutants. However, PM_{10}, O_3 and NO_2 remain the most problematic pollutants. As an example, preliminary data for 2010 shows that approximately 43% of the EU's population was potentially exposed to ambient air concentrations of fine and coarse particulate matter (PM_{10}) in excess of the EU daily limit value set for the protection of human health. In a European Commission college debate on 18th January this year it was concluded that there should be a comprehensive review of the air quality policy by 2013 at the latest. As such, the Commission already launched the review of its air quality policy building on the 2005 Thematic Strategy on Air Pollution and Clean Air for Europe (CAFÉ) initiative. More information on the review of EU Air Policy is available at:

http://ec.europa.eu/environment/air/review_air_policy.htm

An overview of the current European legislation in the field of air quality is presented. The new Directive 2008/50/EC[1] merges and streamlines existing legislation (with the exception of Directive 2004/107/EC[2] also known as the 4th Daughter Directive) without changing the existing air quality objectives. The same new Directive sets also air quality objectives for $PM_{2.5}$ including the limit value and exposure related objectives; it clarifies the treatment of contributions from natural sources; and, provides, under certain conditions, more time to comply with PM_{10}, NO_2 and benzene limit values.

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[1] OJ L 152. 11.6.2008
[2] OJ L 23, 26.1.2005

Meeting the EU Limit Values in the UK

Tim Williamson

DEFRA, UK

ABSTRACT

Trends In No_2 And Pm_{10} Concentration In The Netherlands

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ABSTRACT

Measurement data for PM_{10} and NO_2 from the Dutch national air quality network have been combined with the air quality networks from the cities of Amsterdam and Rotterdam. This enables trend analysis involving up to 50 measurement stations. Trend analyses were performed for the periods 1993-2010, 1999-2010 and 2004-2010.

The results show that on average, annual mean PM_{10} levels decreased with 0.7 $\mu g/m^3$ per year. In 2010 PM_{10} exceedances of the limit values were not measured. With a decreasing trend exceedances are therefore not expected in future years although exceptions may occur in years with unfavourable weather conditions (like the first few months in 2011). To reduce the effects of meteorology in the PM_{10}–trend analysis a regression model normalisation has been performed. Normalised PM_{10} levels show a comparable decreasing trend however the uncertainty in the trend is much smaller[1].

Also for NO_2 a steady decrease is present since 1993. This decrease is much smaller than the decrease in NO_x (NO_2+NO). This difference is mainly caused by the increase in the fraction of NO_2 in NO_x emitted by road traffic. Both for PM_{10} and NO_2 trends are within the uncertainties consistent with trends in emissions.

The data set contains 15 traffic stations. At 7 stations annual mean NO_2 concentration exceeded 45 $\mu g/m^3$ in 2010. Although NO_2 concentrations are decreasing the annual reduction is too small to ensure compliance with the limit value of 40 $\mu g/m^3$ in 2015 (The Netherlands has a time extension until 2015 for NO_2). Therefore additional measures are necessary and foreseen in the Netherlands National air quality plan[2].

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[1] R. Hoogerbrugge, H.A.C. Denier van der Gon, M.C. van Zanten and J. Matthijsen, "Trends in Particulate Matter". PBL-Report 500099014/2010.
[2] http://www.infomil.nl/english/subjects/air/air-quality/

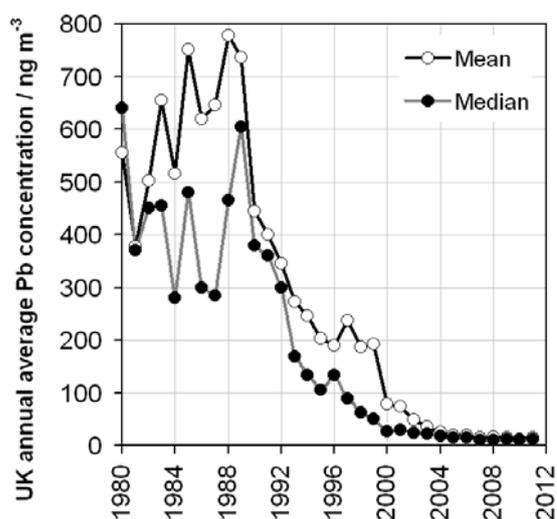# The Past, Present And Future Of Metals and PAH Monitoring In The Uk

Richard J. C. Brown*, David M. Butterfield, Sharon L. Goddard, Andrew S. Brown

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National Physical Laboratory, Teddington, TW11 0LW, UK

ABSTRACT

The presence of 'heavy' metals and polycylic aromatic hyrdocarbons (PAHs) at measureable levels in ambient air remains a health concern in much of the world. These pollutant classes contain some of the most toxic compounds regulated in Europe by the Ambient Air Quality and Fourth Daughter Directives. The expected incorporation of the Fourth Air Quality Daughter Directive (covering Ni, As, Cd, Hg and PAHs) into the 2013 Revision of the Ambient Air Quality Directive (the current

UK annual average ambient PM_{10} lead concentrations 1980-2011

version of which covers Pb) offers an opportunity to examine the practical aspects of monitoring for these species in ambient air, and to provide a perspective on what might the future might hold for these measurements, in 2013, and beyond. As the current operator of the UK Urban and Industrial Heavy Metals and UK PAH Networks, NPL is responsible for 95+ % of the measurements made in support of the UK's obligations under the Fourth Air Quality Daughter Directive. A brief review of the current and historical operation of, and data from, these Networks in the UK will be presented, followed by some of NPL's current air quality measurement research work, which might help to answer policy questions relevant to the Directive revision such as:

- Do the current UK Networks cover all relevant sources of Directive pollutants?
- Are ambient concentrations reflecting decreases in estimated emissions?
- Should gaseous mercury and/or PM_{10} mercury measurement in urban areas be mandated?
- Are credible alternative measurement techniques available for metals and PAHs in PM_{10}?
- Is benzo[a]pyrene a suitable marker compound for PAHs in ambient air?

Towards An Improved Harmonization Of Regional Scale Air Quality Monitoring In Europe – The Role Of EMEP In Providing Information To Support Future EU Directives

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Norwegian Institute for Air Research,
Head of the EMEP Chemical Coordinating Centre (EMEP-CCC), kt@nilu.no

ABSTRACT

The main objective of EMEP is to provide Governments with information of the deposition and concentration of air pollutants, as well as on the quantity and significance of the long-range transmission of air pollutants and fluxes across boundaries.

Monitoring of air concentrations and deposition fluxes was initiated in the 1970ies, and the efforts have gradually expanded to cover variables relevant to address acidification, eutrophication, photochemical oxidants, heavy metals, persistent organic pollutants, and particulate matter/aerosols. The monitoring programme has direct relevance for, and is actively used by other international frameworks addressing Air Quality (i.e. the EU Air Quality Directives, Climate change (WMO), Persistent Organic Pollutants (UNEP), Biodiversity and Biogeochemical Cycles (UNEP, IGBP), Marine environment (HELCOM, OSPAR), Arctic pollution (AMAP) and others.

EMEP monitoring obligations are developed through discussions with the scientific community, with national representatives of the EMEP Task Force on Measurements and Modelling (TFMM) and with the EMEP Steering Body before endorsement by the CLRTAP Executive Body (EB). *The monitoring strategy for 2010-2019* was adopted at the EB in December 2010 and can be found at www.unece.org/env/documents/2009/EB/ge1/ece.eb.air.ge.1.2009.15.e.pdf'

The Directive 2008/50/EC have several references to the EMEP monitoring strategy in relation to the requirements for monitoring at rural and background sites. On the strategic level, there are also obvious benefits of taking advantage of EMEP monitoring obligations to ensure efficient use of resources. Data from EMEP sites are normally also reported to the Commission as part of the national reporting obligations.

As the Directive has its main focus on Air Quality and population exposure in relation to air quality limit values, its development has however differed from the processes established under CLRTAP. As a result, monitoring obligations are not fully harmonized regarding background monitoring. So while the objectives and selection of variables are close to identical, minor differences on the technical level have resulted in requirements where Directive requirements have taken priority and in some cases resulting in the termination of long-term EMEP data series due to cost limitations nationally. EMEP has as a result of this initiated a process to discuss how its monitoring requirements can be founded in the future monitoring requirements of the revised Air Quality Directive. EMEP is a stakeholder to the revision process, and this presentation aim to introduce the status of these efforts, as well as to argue for the benefits of developing a cost efficient approach to ensure continuation of essential long-term data series.

Intercomparisons Of Carbonaceous Aerosol Source Apportionment Models At Various Urban Sites

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[f]LCME, Université Savoie-Polytech'Savoie, Chambéry, France

ABSTRACT

We investigate here the origins of carbonaceous aerosols (Organic and Elemental Carbon) at various French urban sites (Paris, Marseille, Grenoble, ...) using different source apportionment models applied to filter-based (including ^{14}C and organic tracers), Aerosol Mass Spectrometer, and multi-wavelength Aethalometer measurements.

Discrepancies within results of the different receptor models are assessed to be mainly due to differences in the conceptual hypotheses made for each of them. For instance, the Chemical Mass Balance approach aims at apportioning the whole mass of carbon emitted by primary sources whatever the chemical state of primary organic aerosols (unreacted or reacted), while the Positive Matrix Factorization approach applied to AMS measurements is very likely to treat processed/oxidized primary organic aerosols (OPOA) separately from unreacted POA. Results of source apportionment model intercomparisons thus help better understanding the significance of heterogeneous oxidation processes and traditional secondary organic aerosol formation affecting particles of different origin (local vs. regional).

The observation of significant discrepancies in some cases (e.g., high influence of biomass burning emissions) also raises the issue whether source apportionment studies should estimate the remaining unreacted constituents of primary emissions or the amount of particulate matter that are related to both unreacted and processed primary emissions.

Reduction Of Black Carbon And Co2
In Urban Environments

Jim Mills
Air Monitors Ltd

ABSTRACT

CARBOTRAF is a three year program, studying the relationship between traffic flow and emissions of black carbon (BC), and CO_2 in urban environments.

The two host cities of Glasgow, Scotland and Graz, Austria were chosen due to their ability to manage traffic flows using Intelligent Transport Systems (ITS), which will be connected to real time air quality monitoring data and a decision support system provided by IBM Inc.

Pilot studies in the Netherlands have shown that traffic flow/volume correlates more closely with BC than with PM10/2.5 or CO_2 so the project will therefore focus initially on BC emissions.

BC is second only to CO2 in terms of global warming but stays in the atmosphere for only a few weeks, so any reduction provides benefits almost immediately, in contrast to CO2. In a recent study the UNEP estimates that we could quickly reduce 'near-term' global warming by 0.5°C by tackling BC emissions alone.

BC reductions would also have significant benefits to human health and could help prevent hundreds of thousands of premature deaths.

The presentation will explain the aims and objectives of the program and will show how data from traffic, meteorological and air quality networks can be combined in real time, empowering decision support systems, to improve the accuracy of computer modelling and leading to eventual improvements in air quality and a reduction in global warming effects. CARBOTRAF will produce a handbook for government authorities to assist in the implementation of similar carbon reduction strategies through better traffic management.

Carbonaceous Aerosol Measurements At An Urban Area In The Po Valley, Italy

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ABSTRACT

The carbonaceous species are among the major constituents of atmospheric aerosols. In Europe, they account up to 38% of the mass concentration of aerosol particles with diameters lower than 2.5 μm (PM2.5). Since the organic (OC) and elemental carbon (EC) contained in aerosol particles have both health and climatic implications, the knowledge of their availability and variability is important.

This work shows measurements of OC and EC aerosol concentrations observed at ENEA - Bologna Research Centre (44°30'N, 11°21'E) during winter 2011. The site is located in a densely populated residential area, close to a road, therefore it has the characteristics of an urban traffic air quality monitoring station.

The hourly measurements were performed with a semi-continuous OC/EC analyzer (Model-4 Field analyzer, Sunset Lab.) while the daily measurements are from analysis of 24 hours filter samples with the OC/EC laboratory instrument (Sunset Lab). Both instruments have used the EUSAAR-2 protocol for thermal analysis. In order to better understand the OC/EC aerosol mass concentration in relation to particle number distribution, real-time particle concentration measurements performed with a Condensation particle Counter (WCPC 3785 Tsi) are also shown. Temporal variations of carbonaceous aerosols over the days of the week are examined. In additions, the results from the intercomparison of the two instruments in a heavy polluted aria are discussed.

Optical Detection And Discrimination Between Biomass And Fossil Fuel Combustion: Influence On Air Quality In Different Environments

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ABSTRACT

Elevated concentration of particulate matter is one of the most important air quality problems faced in urban areas. Carbonaceous aerosols are a major contributor to the particulate mass. Emissions of these aerosols are caused by incomplete combustion of fossil fuels and biomass (including wood). In recent years contribution from biomass combustion is increasing because it is promoted as a renewable fuel, due to its lower price compared to fossil fuels and relative ease of procurement. However, carbonaceous aerosols have a negative impact on human health, visibility and ecosystem and their accurate determination is important. Despite of considerable efforts during the last years, measurements of carbonaceous aerosols are still associated with considerable challenges.

Using the "Aethalometer model", BC and carbonaceous aerosol mass was apportioned to combustion of fossil fuel and biomass. The results of the apportionment will be presented and relation to other analyzed parameters will be discussed, focusing especially on tracers of biomass combustion, for different environments. This includes towns where biomass combustion was traditionally used for domestic heating and larger cities where biomass was not thought to play a major part in particulate air pollution.

We will particularly focus on contributions from fossil fuel and biomass burning on air quality in different towns with different geographical settings in the pre-Alpine region of Slovenia, where extended campaigns were performed. In all locations aerosol light absorption was measured by a multi-wavelength Aethalometer (Magee Scientific AE31-ER) with a 5 min time resolution, and PM10 sampling was performed. Filters were later analyzed for the content of major anions and cations, OC and EC, levoglucosan and trace elements. Analysis of OC and EC was performed by OCEC analyzer (Sunset Laboratory) with EUSAAR_2 protocol. Biomass combustion is a significant contributor to air pollution in all examined locations with diurnal cycles clearly different from the diurnal cycles of fossil fuel combustion.

Air Quality Monitoring Of Black, Elemental And Organic Carbon In Flanders, Belgium

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Jordy Vercauteren, Leen Verlinden and Edward Roekens

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ABSTRACT

1. Introduction

Important health problems are associated with elevated fine dust concentrations. Altough levels did decrease during the last decade, actually still some part of the Flemish population is exposed at PM10 concentrations above the daily limit value. Based on PM2.5 measurements in city background stations a decrease in PM2.5 concentrations by the year 2020 of 20% has to be realised. Actually more and more attention is paid to the measurements of elemental carbon and/or black carbon.

2. Monitoring of EC and BC in Flanders

Black smoke is the oldest parameter that is measured in the Flemish network. Measurements started in 1968 using the manual OESO method and measurements have been done at up to 100 stations. In 2003 the manual measurements were replaced by measurements using the automatic monitor ETL SX200 at six places. In the near future the ETL SX200 monitors will be replaced by MAAP monitors. From 2007 onwards measurements by MAAP monitors were introduced in the network. Elemental and organic carbon (EC/OC) measurements have been done during several chemical characterisation campaigns. The focus of the last chemical characterisation campaign was on the contribution of wood burning.

3. Results and discussion

The results of the elemental and black carbon/smoke measurements will be discussed. A comparison of the different measurement methods for elemental and black carbon/smoke (ETL SX200, MAAP, EC by laboratory analysis using the NIOSH protocol) at several places will be given and discussed. Results on the contribution of wood burning to total organic matter will be presented.

Intercomparison Of Thermal-Optical Protocols Currently Used In France And Europe For The Assessment Of Ambient Air Organic And Elemental Carbon Within PM

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ABSTRACT

Since 2008, The French Central Air Quality Surveillance Laboratory (LCSQA) has been working on setting up harmonized PM sampling and chemical speciation methods in concordance with the European Directive (2008/50/CE) which requires $PM_{2.5}$ chemical speciation on rural sites. At these rural background areas, $PM_{2,5}$ measurements must include at least the total mass concentration and concentrations of anions and cations, and of elemental and organic carbon (EC/OC).

Even if the thermal-optical method, considered by the European normalization works as a reference method to quantify EC/OC, has been widely used for many years, it is still suffering from a lack of information on the comparability of the different analytical protocols (temperature protocols, type of optical correction) currently used in the laboratories.

To better evaluate EC/OC data set quality and related uncertainties, the LCSQA has organized the first EC/OC comparison exercise for French Laboratories using different thermo-optical methods. It has also compared the results obtained for the analysis of samples from different European sites with the optical reflectance (TOR) and transmittance (TOT) OC charring corrections.

While there are good agreements on total carbon (TC) measurements among all participants, some discrepancies can be observed on EC/OC ratio results even among laboratories using the same thermal protocol. As for the TOT/TOR comparison, differences can be observed and seem to depend on the sample carbon content.

In conclusion, hints are proposed for future work to help determining the most appropriate reference method for EC/OC measurement in a normalization context.

The European Commission's Expectations from the AirMonTech Project

Michel Schouppe

EU Commission, Belgium

ABSTRACT

Existing Monitoring Technologies for Regulated Metrics

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Empa, Swiss Federal Laboratories for Materials Science and Technology,
Air Pollution/Environmental Technology Lab., Duebendorf Switzerland

ABSTRACT

With increasing requirements for air pollution monitoring in Europe and the rising number and complexity of available instruments, harmonisation and innovation of air pollution monitoring in Europe is of vital importance. In the short term, harmonisation is needed to ensure comparability of concentration data (and the associated measurement uncertainties) measured by European air pollution monitoring networks. One of the main objectives of the EU FP7 project AirMonTech is to support harmonisation of air pollution monitoring in Europe by providing relevant information, recommendations and guidance for the operation of available measurement technologies. This information will consist of an extensive collection of standard operating procedures (SOPs) for set-up, operation and calibration of instruments, type approval reports for automated air pollution monitors, and reports on equivalence tests of automated monitors for PM2.5 and PM10. In addition, documents will be prepared that provide background information about regulated (and other) air pollutants including an overview of the current knowledge on health effects, descriptions of existing measurement technologies and their specifications. All this information will be easily accessible for everybody via a web-based database. Although the compilation of this information within AirMonTech is currently still in progress, we will already show examples of documents and information which interested users (e.g. network operators) can expect regarding operation of air quality monitoring instruments and support towards harmonised air pollution monitoring.

New Monitoring Technologies, New Metrics and Proxies

Ulrich Quass

Institute of Energy and Environmental Technology, IUTA e.V, Air Quality & Sustainable Nanotechnology, Duisburg Germany

Urban air quality monitoring networks are requested to provide accurate and relevant data on air pollution levels which serve as basis to assess limit value compliance and the need of mitigation actions. Scientific and technological progress as well as new epidemiological and toxicological research results trigger a continuous demand to re-adjust the monitoring strategies and instrumentation.

On this background one major task of the EU FP7 project AirMonTech is to collect and evaluate information on recently developed and future monitoring technologies for regulated and potential future pollutants and proxy metrics. This information is obtained from scientific literature and manufacturer's files, and is processed in a standardised way to make it accessible via the AirMonTech database.

Although this process has not yet been accomplished, some general trends in monitoring instrumentation and regarding new metrics and proxies are already apparent. On the one hand, multi-component monitoring instruments increasingly gain attraction, on the other hand the development of miniaturised and mobile instruments offer new monitoring approaches which might be more suitable for exposure assessment than current approaches. The difficulties to translate the well-established health effects of particulate matter into toxicological mechanisms further motivates the development of monitoring technologies for specific physico-chemical particle proxies which are thought to better reflect the health relevant fraction of the ambient aerosol than its total mass. While some of these more advanced multi-component are already marketed and used in air pollution research others still have to be further developed to make them usable with AQ monitoring networks.

WP 3: The AirMonTech database

Annette Borowiak[a], Maurizio Barbiere[a] and Luca Spano[b]

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ABSTRACT

The FP 7 AirMonTech project (www.airmontech.eu) aims at improving and harmonising air pollution monitoring techniques. Within the framework of the project the AirMonTech database has been created, that collects, organises and stores all relevant documents and data related to recent technologies and new generation technologies for air pollution monitoring. Standard operation procedures (SOP) for operation of monitoring techniques, reports on type approval or equivalence testing and other relevant documents shall populate the database when going online. A user friendly a web application has been developed, to translate users' actions into commands performed over the system. A middle tier set between the user interface and the database coordinates the commands, makes logical decisions, performs calculations and returns logical views of the stored data.

The database system allows to download documents, to search the database with the help of predefined filters mainly based on specific meta tags assigned to the documents during the uploading process and to perform a full text search in the database. Furthermore, the system allows data drill down, moving from summary information to detailed data.

Authenticated users are authorised to access specific areas of the system. Editors collect documents, describe their contents with the help of predefined meta tags and upload data and files to the AirMonTech database. Publishers validate, filter and organize logically any suggested information in the catalogue. This validation process allows to structure and to organize the unstructured information collected.

End users can search through a well organized catalogue of information related to air pollutants (and further general information on the pollutant), measurement techniques related to the pollutant, instruments/technologies available for the measurement and finally standard operation procedures for the different technologies and equivalence/type approval tests where available.

The information flow, inputs and outputs of the database will be discussed with the air quality monitoring community in AirMonTech project workshops and at AQUILA Network (http://ies.jrc.ec.europa.eu/aquila-homepage.html) meetings.

Baseline And Low Emission Zone Scenario Modelling To Support The Development Of UK Air Quality Plans For No$_2$ Compliance

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AEA,
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ABSTRACT

The PCM model has been used to support the development of UK air quality plans for the assessment of compliance with the limit values for NO$_2$ set by the Air Quality Directive (2008/50/EC). The model has been used to carry out a compliance assessment for a base year of 2008 and to calculate baseline projections for 2015 and 2020. The model provides estimates of annual mean NO$_x$ and NO$_2$ for 1 km grid squares across the UK and concentrations for over 9000 individual receptors at the roadside of urban major roads.

Projections of annual mean NO$_X$ and NO$_2$ concentrations in 2015 and 2020 including the impact of a targeted Low Emission Zone (LEZ) measure have also been calculated to inform the development of the air quality plans. The scenario modelled is to illustrate the NO$_2$ emission reductions a LEZ could bring. The LEZ scenario would require all buses and HGVs to meet at least EURO IV standards for both NO$_X$ and particulate matter (PM$_{10}$) emissions by 2015. All of the London boroughs and a total of 41 local authorities outside London have been included in the modelling assessment for the LEZ scenario. These local authorities have been selected following a detailed analysis of the PCM model results for the baseline and a hypothetical scenario in which the LEZ applied everywhere.

This presentation will include a description of the modelling methods used and summary results from the baseline and scenario modelling assessments in terms of extent of exceedance and maximum concentrations.

Recent Evidence And Future Prospects Relating To No$_x$ And NO$_2$ Emissions From Road Vehicles

David Carslaw
King's College London

ABSTRACT

NO$_x$ emissions from road vehicles have been a concern for several decades. NO$_x$ emissions play a central role in many important environmental issues from the direct health effects of NO$_2$ to the role that NO$_x$ has in ozone formation, which is important at a regional and global scale. Despite continuously tightening emissions legislation in Europe, emissions of NO$_x$ remain stubbornly high, with important consequences for meeting the limits set by European Air Quality Directives. While 5-10 years ago it was widely believed that the annual mean NO$_2$ Limit Value of 40 μg m^{-3} would be met by 2010, it is now clear that this will not happen for another 10-15 years.

This talk will briefly review the recent trends in ambient concentrations of NO$_x$ and NO$_2$ in the UK and Europe and show how these trends vary by location. In most urban locations concentrations of NO$_2$ for the past 5-8 years have stabilised or have only weakly decreased.

The main part of the talk will consider the recent evidence from the analysis of a large sample of vehicle emission remote sensing data from several campaigns carried out in the UK. The analysis of these data reveals many important findings concerning NO$_x$ emissions from vehicles. It is found that older catalysts-equipped petrol vehicles (Euro 1 and 2) emit considerably more NO$_x$ than previously thought. In addition, there remain substantial numbers of these vehicles in the UK fleet – ensuring they make an important contribution to total NO$_x$ emissions. Emissions from diesel cars and vans are also shown to be higher than previous estimates such as those used in the compilation of the UK National Atmospheric Emissions Inventory. Furthermore, the emissions from these vehicles have changed little, or may even have increased in the past 20-25 years. In addition, over the same time diesel emission control technologies have increased the proportion of the total NO$_x$ that is NO$_2$.

In more recent work, quantile regression techniques have been used to explore the importance of vehicle specific power in relation to emissions of NO$_x$ from passenger cars. This work reveals important vehicle emission characteristics observed for NO$_x$ but not for other pollutants when vehicle engines are under higher loads. In particular, it is found that older (Euro 1 and 2 petrol) cars and newer (Euro 3 to 5) diesel cars emit considerably more NO$_x$ for higher levels vehicle specific power. This work has important implications for estimating emissions from vehicles because there is an increased dependence on driver behaviour that was previously absent. It may also imply that a single drive cycle will fail to adequately capture these characteristics.

Nitrogen Dioxide Measurement Ambient Concentrations And Future Control Measures

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ABSTRACT

Central Brighton and Hove has one of the highest population densities in the UK. The city council has mapped in detail enduring exceedence of Nitrogen Dioxide (NO_2) and since 2008 monitoring evidence strongly suggests an increase in concentrations with little tangible improvement in the past five years. At worse-case locations the limit value continues to exceed by a factor of two. The presentation will use real case studies from the city centre and surrounding villages to explain linkages between emissions sources and façade concentrations adjacent to living quarters.

There will be some discussion on vulnerable groups and the greater success that neonatal doctors now have in keeping very early births alive in combination with an ageing UK population.

In accordance with the latest guidance the council is targeting monitoring resources at priority areas that are relevant to the averaging period of the EU limit value. Defra's model estimations for agglomeration compliance are considered to be over optimistic and unrealistic. The model predictions are verified against a former AURN monitor that resides outside of the council's current priority area for NO_2.

In the light of the possibility of fines from the EU to councils it is essential that city authorities use their latest findings and experience to contribute fresh ideas to the debate on action plans and policy. In many cases the standard policy of: transport alternatives to the private-car and zones with at least Euro-V diesel vehicles will not be sufficient to mitigate the problem. Key messages in the cities very latest action plan (2011) will be presented.

Low-Cost Sensor Networks For Measuring Urban Air Quality

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ABSTRACT

Current air quality measurement methodologies rely either on sparse networks of frequently expensive instruments (e.g. the AURN network in the UK) or higher density low time resolution networks e.g. utilising NO_2 diffusion tubes. As a result, in many cases important aspects of urban air quality, for example spatial and temporal granularity and 'hot spots' cannot be reliably captured, meaning that a true picture of urban air quality cannot be gained and that derived quantities e.g. personal exposure will be unreliable.

Miniature low cost gas sensors using electrochemical technologies are now at a stage where key air quality gases such as CO, NO & NO_2 can be measured at the low mixing ratios (~ppb for NO_x, 10s of ppb for CO) ubiquitously present in the European urban environment. The ability to operate at these very low levels using small, low power sensors enables air quality measurements to be made using high density dispersed sensor networks with minimal infrastructure and cost overheads, potentially revolutionising urban air quality monitoring philosophies.

In this paper we show results which illustrate the fundamental capabilities of modern electrochemical sensors in both the laboratory and the field. We show results from a number of multi-sensor network deployments (40-50 sensor nodes) obtained in complex urban environments, operated in both static and mobile modes. Finally we show a range of air quality diagnostics derived from the sensor network data, including comparisons with local AURN sites.

Key Findings from the UNEP Report on Integrated Assessment of Black Carbon and Tropospheric Ozone

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ABSTRACT

Black carbon (BC) and tropospheric ozone (O_3) are known to have a negative impact on human health and ecosystems and to contribute to climate change warming the atmosphere. The United Nation Environmental Program (UNEP) and World Meteorological Organisation (WMO) performed an integrated assessment of emissions, concentrations and impacts of BC, ozone and its precursors. The study identified mitigation measures that could provide a win-win solution, reducing global climate change and providing air quality benefits. One group of measures is designed to reduce BC and has a considerable effect on organic carbon, $PM_{2.5}$ and CO emissions. Reduction of methane emissions is the target of the second set of measures. The degree by which these emission measures can help protect near-term global and regional climate change and have co-benefits on human health and crop yield was evaluated applying two global climate models. Model results showed that full implementation of measures could reduce the global mean warming by 0.5 degree (by 2070) compared to a scenario based on current policies. If CO_2 mitigation measures are implemented together with the proposed near-term measures the temperature increase could stay below the 2 degree limit above the pre-industrial level. The implementation of the identified measures leading to reduction of $PM_{2.5}$ concentrations could help avoid 2.4 million (0.7–4.6 million) premature deaths annually in 2030. Furthermore a large reduction of O_3 concentrations is found and a loss of 1–4 per cent of the global production of maize, rice, soybean and wheat each year could be avoided.

From Air Quality To Climate Change -
A Switcher's Perspective

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ABSTRACT

Those concerned about air quality and climate change study the same atmosphere but are generally concerned about different aspects of how it affects us and our planet. This talk will reflect on some of the links between air quality and climate change, and the possibilities for greater cooperation between scientific communities to achieve the greatest overall environmental benefit.

Climate models are used to understand the effects of perturbations to the 'Earth System'. Such models are capable of giving far more information about such perturbations than simply the warming effect of increased carbon dioxide concentrations. The latest generation of Met Office Hadley Centre climate models provide a wealth of information that is both directly and indirectly relevant to air quality-relevant species. This includes aerosols, atmospheric chemistry and a wealth of linkages to the oceans and land surface. The first part of the talk will give a general overview of the models and some research highlights.

The second part of the talk will try to look forwards to how the climate change community might interact more effectively with the air quality community. Here there is an interplay of co-benefits, trade-offs and diverse stakeholders that sets a real challenge for those tackling the air quality and climate change issues.

POSTER ABSTRACTS

Sensor Arrays For Air Pollution Monitoring

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ABSTRACT

The monitoring and control of air pollution can be greatly assisted by having access to data showing the spatial extent of the pollution, as well as time resolved data. This spatial information is normally not easily available as monitoring stations are few and far between. Other methods, such as diffusion tubes, are labour intensive and do not give time resolved data.

Advances in several technologies have now made the use of arrays of relatively low cost monitors a reality.

Low cost electrochemical cells are now available capable of measuring at the ppb level for NO, NO2, Ozone, and SO2. This makes the prospect of an array of monitors one that can be achieved at a reasonable cost.

Advances in batteries and low power electronics have also allowed monitors to be designed that do not need external power, and new wireless techniques can be used for the transmission of data.

A system is described that uses an array of self powered wireless monitors. The system utilises the new sensors, transmits data in real time, and has been designed for ease of installation.

Data showing the performance of the sensors is presented, and their performance is compared to data from nearby certified monitors.

Assessment Of The Level Of Sea Salt
In Pm₁₀ In The Netherlands

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ABSTRACT

Recent measurements of sodium in PM_{10} reference samples allow a more accurate estimate of the sea salt contribution in the Netherlands. Currently, estimates of Dutch sea salt levels are based on chloride measurements. This old chloride based method was used as input for EU discussions over Guidelines for determination of the contribution of natural sources on the PM_{10} concentration[1]. The old method is also the basis for the current legislation which allows the subtraction of the sea salt concentrations in the assessment of PM_{10} concentrations. New measurements of sodium in PM_{10} show that the current legislation overestimates the annual averaged sea salt contribution by 50 % and therefore requires an update.

In the update the geographical differentiation is obtained by using the LOTOS-EUROS air quality model. The sensitivity of sea salt levels in LOTOS-EUROS to relevant parameters in the sea salt deposition scheme was studied and the configuration which provided a good match with measurements of sea salt levels was selected. The annual average varies from 1 $\mu g/m^3$ for municipalities near the south eastern border to 4 $\mu g/m^3$ at many coastal sites.

For application on PM_{10} exceedance days (PM_{10} > 50 $\mu g/m^3$) the modelled sea salt concentrations in the relevant PM_{10} range were averaged and calibrated to the corresponding measurements. With a general statistical relation the sea salt levels on exceedance days are transformed into the number of exceedance days due to sea salt and can therefore be ignored in compliance testing. This number of days varies from 2 for inland provinces to 4 days for coastal provinces.

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[1] SEC(2011) 208 Establishing guidelines for demonstration an subtraction of exceedances attributable to natural sources under the Directive 2008/50./EC on ambient air quality and cleaner air for Europe

ClearfLo: Clean Air for London

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ABSTRACT

High temperatures and poor air quality have a demonstrable effect on human health in urban areas. However, the processes responsible for generating the main pollutants, namely ozone, particulate matter, and NOx, and the special interaction with the urban atmospheric boundary layer are not well understood. The NERC-funded ClearfLo project (www.clearflo.ac.uk) is a large multi-institution project that is establishing integrated measurements of the meteorology, composition and particulate loading of London's urban atmosphere, complemented by an ambitious modeling programme.

We have established new measurement capabilities at street level and at elevated sites that are now making long-term measurements together with parallel high resolution modelling. In this way we aim to identify the seasonal cycle in the meteorology and composition, together with the controlling processes. Two intensive observation periods are being planned to complement the long-term measurements. The IOPs take place in winter 2012 and during the Olympics in summer 2012 and aim to measure London's atmosphere with higher level of detail. The main aims of the IOPs are (i) to determine the vertical structure and evolution of the urban atmosphere (ii) to determine the chemical controls on ozone production, particularly the role of biogenic emissions and (iii) to determine the processes controlling the evolution of the size, distribution and composition of particulate matter. This paper gives an overview on the measuring and modeling activities within the ClearfLo project.

Black Carbon Exposure During Different Modes Of Transport In Stockholm, Sweden

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ABSTRACT

Recent studies suggest that particles from combustion sources are more health relevant than particles from other sources. Therefore, black carbon (BC), a traffic-related combustion by-product and a component of particulate matter, is useful as an additional indicator in air quality management.

Since ambient levels of BC are not well-characterized, the aim of this study was to examine personal exposure levels of BC during different modes of transport in Stockholm, Sweden.

Participants carried aethalometerswhile simultaneously walking, biking and travelling by bus, respectively, during approximately 20 minutes along the same stretch of a busy inner-city streetin peak hour. For comparison, a participant travelled by underground approximately the same route (6 min) and spent time on underground platforms before (6 min) and after (6 min) the trip. Real-time aerosol black carbon was monitored at a time resolution of 1-minute and expressed as ng/m^3 (medians).

The BC levels during walking and biking were similar (1080 ng/m^3 and 1460 ng/m^3, respectively). Travelling by bus rendered higher exposure levels, 4830 ng/m^3, which was in the same magnitude as travelling by underground, 4260 ng/m^3. However, the highest exposure situation occurred while waiting at underground platforms, 13 900 ng/m^3.

In conclusion, our study shows that exposure to black carbon while travelling by public transportmay be a significant part of the total personal exposure. These findings need to be investigated further, including comparisons with other microenvironments and activities. Measuring black carbon is reasonably cost-effective and can be used as a proxy of personal exposure to traffic-related particles.

Indoor Air Quality Monitoring

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ABSTRACT

Improvements to home insulation that reduce ventilation may impact the health of building occupants through increased concentrations of gases derived from heating, cooking and other sources. Consequently, this research focuses on the measurement of indoor concentrations of SO_2, NO_2, CO, CO_2, TVOCs, temperature and humidity associated with the use of energy in homes.

An instrument has been developed that is capable of passively logging indoor and outdoor concentrations of these gases in real timeevery 60 seconds over a 14 day period.To test the device, eleven homes – with a mixture of gas or electric for cooking and heating - were monitored in London, Manchester and Sheffield. Monitoringwas performed during two periods for each home to determine whether air quality was affected by reduced ventilation and increased heating during the winter months compared to summer months when heating was not used. Three units werelocatedwithin each house: in the kitchen;the lounge; and the outside. Comprehensive user diaries supplemented the data.

The devices succeeded in collecting the data which have been analysed using standard statistical techniques, principal components analysis and indoor/outdoor ratios. Analyseddata can be used for optimising the design of new housing stock and to investigate ventilation associated problems in existing dwellings.

The AirMonTech Project:
Current and Future Air Quality Monitoring
Technologies for Urban Areas

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ABSTRACT

With increasing requirements for air pollution monitoring in Europe, and a rising number and complexity of available instruments, harmonisation and innovation of air pollution monitoring in Europe is of vital importance. To achieve harmonised air quality data, detailed recommendations on equipment evaluation and selection, standard operating procedures (SOPs) for set-up, operation and calibration.

The necessity for harmonisation is especially important for particles (PM2.5 and PM10). The regulatory requirements for both metrics and methods need to be re-examined in the light of improved knowledge (especially in relation to health effects) and advances in technologies.

The aim of AirMonTech is to compile the knowledge and information needed to harmonise current air pollution measurements and to guide decisions about monitoring in the future. AirMonTech will gather information on instrument performance, test results, equivalence demonstrations and SOPs, and process them into specifically designed databases. Particular emphasis will be placed on methods for real-time monitoring of particles and particle-related proxy variables as well as indices particularly relevant for human health. A roadmap for future urban air quality monitoring including recommendations on existing and new monitoring technologies will be developed and discussed with stakeholders. Opportunities and limitations for the improvement and harmonization of monitoring activities in EU member states will be evaluated in an interactive dissemination process involving all relevant stakeholder groups. This poster is one of the means.

Bioaerosol Particle Detection
by Flame Plasma Electrochemistry

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ABSTRACT

Real time identification and numeration of bioaerosols is of interest to the health [1], security [2] and fabrication [3] industries. The majority of techniques in this field follow the capture and subsequent analysis methodology [4]. The collected sample may suffer from desiccation or chemical reaction prior to analysis. This technique benefits from the particle remaining under the conditions in which it was sampled until the point of analysis.

Here an approach is presented with results for grass and tree pollens used as model systems. In this approach particles are directed into the heart of a laminar H_2/O_2 flame (Figure 1). A change in the open circuit potential is detected upstream by an array of electrodes. This has been shown [5] to correlate to the plume of gases given off by a single particle as it burns in the flame. Further, the array collects spatial information on the plume to aid differentiation of particles.

When introduced into the flame, a plume of gases *ca.* 10^3 times the particle diameter is produced. This amplification effect allows sub-micrometer particles to be detected.
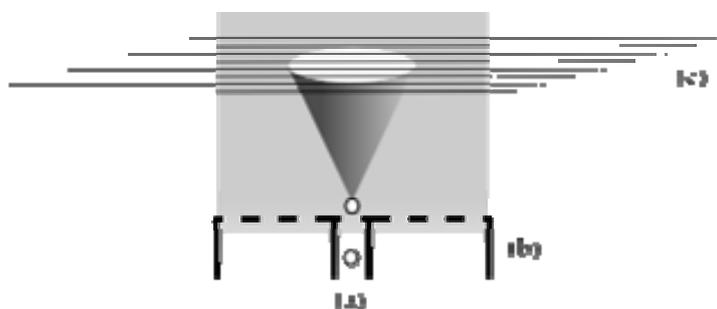
Figure 1. Particles are introduced to the separate central gas flow (a) of a Meker burner (b). Against the background flame (light grey) the particle combusts to produce a gaseous plume (dark grey). The front of this plume is imaged by an electrode array (c).

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