NEWSLETTER

WHO COLLABORATING CENTRE FOR AIR QUALITY
MANAGEMENT AND AIR POLLUTION CONTROL

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CONTENTS

NEHAP NETWORK OF BELGIAN CITIES: HEALTH IMPACT ASSESSMENT OF AIR POLLUTION

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Introduction

In the context of the WHO process on Environment and Health in Europe, Belgian ministers of health and of the environment agreed together on a framework Belgian National Environment Health Action Plan (NEHAP) in 2003 (www.nehap.be). The framework consists in recommendations on seven areas of environmental health policy. Actions taken within that framework are performed in common by both environment and health ministers, commonly funded. They do not succeed if all the partners are not involved and provide results to all parties. Cooperation is indeed required for many actions due to the complex Belgian institutional landscape regarding the areas of environment and health.

During the first phase of the Belgian NEHAP (2003 to 2007), it was decided to develop a network of cities in order to experiment on health impact assessment of air pollution. Such action requires the full cooperation of providers of health, environment and population data. To turn the network to an urban level would furthermore involve local authorities as well.

Although, particulate air pollution in Belgium is one of the highest of Western Europe, until now. A network of Belgian cities did not appear in the „Air Pollution and Health: A European Information System (APHEIS)“ health impact assessments on air pollution. Health impact assessments had been performed for EU Members States during the CAFÉ programme. A more local health impact assessment methodology had been developed by the APHEIS programme (Medina et al. 2001; Atkinson et al. 2001; Medina et al. 2002; Medina et al. 2005). APHEIS is a public health surveillance system that aims to provide European, national, regional, and local decision-makers, environmental health professionals and the general public with up to date and easy to use information on air pollution and public health. It has been performed in several European cities (Ballester et al. 2008). Only the Brussels-Capital Region participated to the „European Environment and Health Information System (ENHIS)“ programme using the APHEIS methodology (Medina et al. 2007).

In the framework of the Belgian NEHAP, health impact assessment (HIA) of air pollution was performed in three Belgian cities using the APHEIS methodology (Atkinson et al. 2001; Medina et al. 2005). The aim of the present study was to prepare the cities of Brussels, Liège and Antwerp to join the international network of cities using the APHEIS methodology and to participate to its next developments. The aim is to verify the availability of needed data, test cooperation and perform the HIA. Results are presented for the three cities.

Methodology

APHEIS developed guidelines for gathering and analyzing data on air pollution and the impact on public health. APHEIS has analyzed the acute and chronic effects of fine particles on premature mortality using the estimates developed by the Aphea study (Atkinson et al. 2001) and two American cohort studies.

This health impact assessment was performed for different scenarios on the health benefits of reducing levels of particulate matter less than 10 µm size (PM_{10}) and ozone. Data are presented for the scenario for acute and chronic exposure above the following defined reference level: for acute exposure, daily concentrations above 20 µg/m^3 and for chronic exposure a PM_{10} annual mean value of 20 µg/m^3. The health benefits associated with a reduction of 5 µg/m^3 of all daily means and of the annual mean are also presented.

The ozone reference concentration level was defined at 120 $\mu g/m^3$. The attributable number of cases is, in other words, the number of preventable cases if the exposure had been lowered to this reference level. The chosen demographic, air pollution, morbidity and mortality data are those of the year 2004.

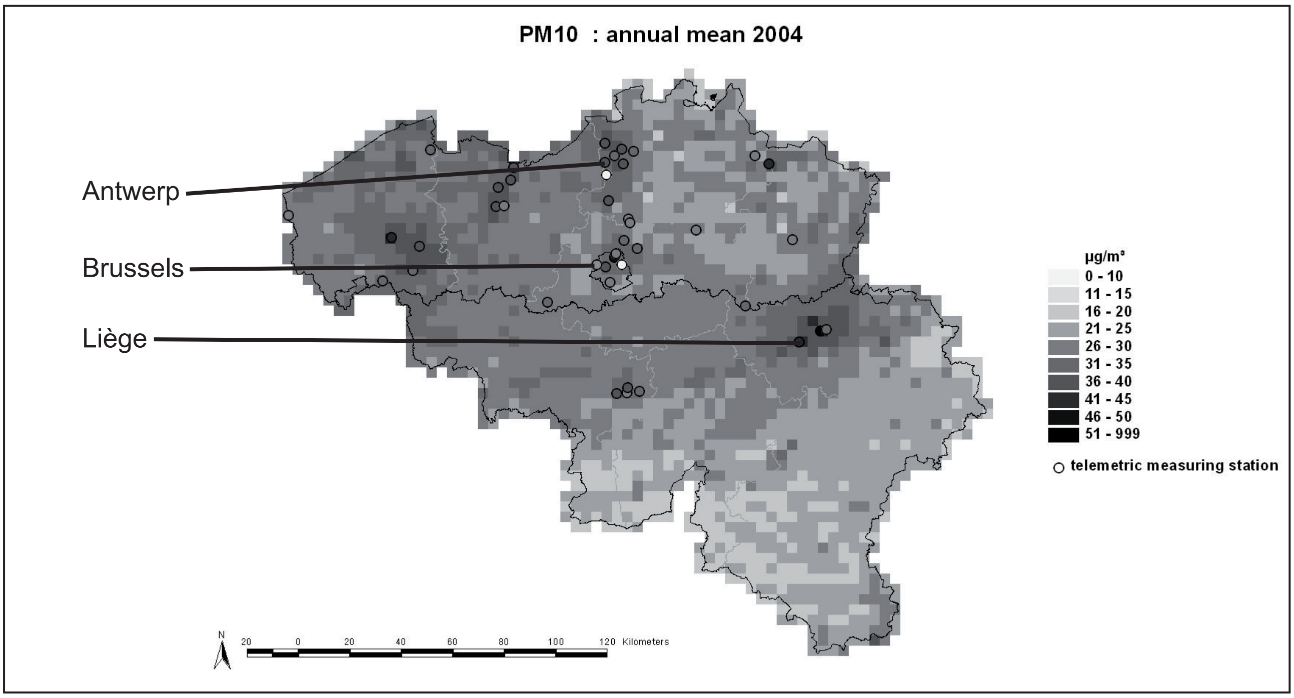

Figure 1: PM_{10} interpolated annual mean concentration in 2004

Results and Discussion

The total population taken into account in this health impact assessment includes nearly two million inhabitants. The three urban areas covered a total of 36 local authorities, respectively 19 for Brussels, 10 for Liège and 7 for Antwerp. The monitoring network of air quality measuring stations is distributed into respectively six background stations in Brussels, two background stations in Liège and one background, one traffic, and one industrial station in Antwerp. HIA was calculated using either measured or interpolated populated weighted air data. Interpolated populated weighted PM_{10} concentrations averaged 32, 34 and 38 $\mu g/m^3$ respectively in Brussels, Antwerp and Liège (figure 1).

The annual number of preventable deaths is calculated for the year 2004, attributed to acute, subacute and chronic exposure for PM_{10} concentrations above 20 $\mu g/m^3$, PM_{10} target value defined in the EU directive (1999/30/EC) and the WHO guideline value.

The impact of short-term exposure on total, cardiovascular and respiratory mortality was the highest in Liège although not significantly different from Brussels or Antwerp. Standardized per 100,000 inhabitants, the acute impact ranges from 7 in Brussels to 11 in Liège (figure 2, see next page).

The corresponding estimates for subacute exposure (1 month delayed) were about twice as high as the acute. The impact of chronic exposure was much greater than the one of acute or subacute exposure. When standardized per 100,000 subjects the impact ranged from 40 in Brussels to 79 in Liège, although the impact did not significantly differ between the cities (figure 3, see next page), as indicated by the 95 % confidence interval.

The health benefit associated with a reduction of 5 $\mu g/m^3$ of the daily mean PM_{10} concentration has been estimated at 56 preventable deaths per year. A reduction of 5 $\mu g/m^3$ of the annual mean PM_{10} concentration would avoid 399 early deaths (or 61 per 100,000 inhabitants).

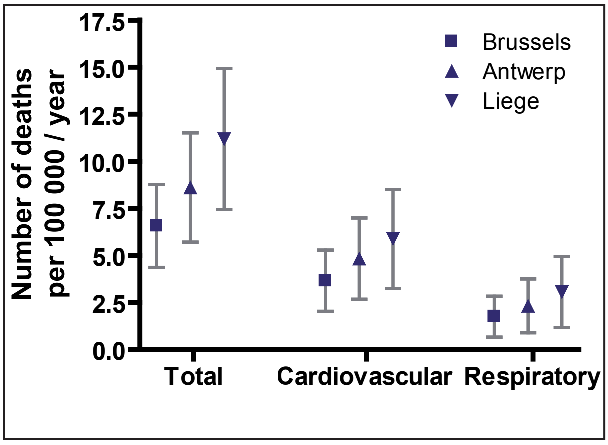

Figure 2: Reduction of daily mean PM_{10} concentration to a level of 20 µg/m³ and impact on total, cardiovascular and respiratory mortality (acute exposure)

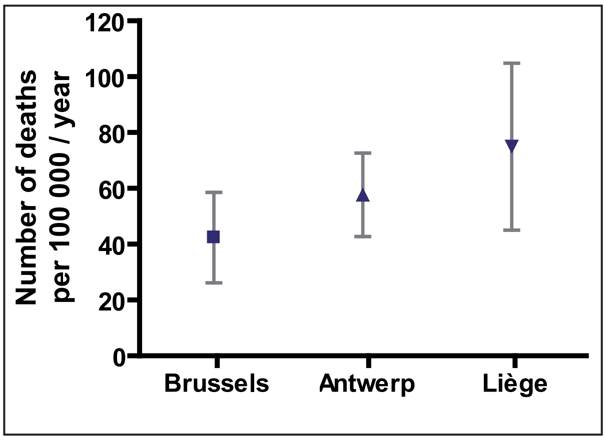

Figure 3: Reduction of the annual mean PM_{10} concentration to a level of 20 µg/m³ and impact on total mortality (chronic exposure)

Regarding ozone, the short-term impact for daily levels (highest 8-hourly averages) above 120 µg/m³ was estimated. The short-term effects due to ozone were generally low. This could be due to the fact that the chosen reference value was rather high (120 µg/m³) and due to relatively low ozone exposure in 2004.
Previous studies in Belgium on the effects of particulate air pollution are limited.

In 2005, an APHEIS exercise was made for Brussels Capital Region based on data for the year 2001 (Bouland 2005). The results showed that a reduction of PM_{10} concentration to a level of 20 µg/m³ would be associated with a benefit in postneonatal mortality of 11.8 per 100,000 infants per year. The same PM_{10} reduction scenario was associated, in the present study, with a benefit of postneonatal mortality of respectively 7, 15 and 9 per 100,000 infants per year for Brussels, Liège and Antwerp area. This same study also showed that a reduction of 10 µg/m³ of the highest daily 8-hour ozone concentrations would induce a health benefit in terms of total, cardiovascular and respiratory mortality of respectively 1.5, 0.8 and 0.6 per 100,000 inhabitants. These results are in the same order of magnitude of those found for the three cities in the present study.

A study carried out in Flanders based on mortality data and air pollution data for the period 1997 to 2003, showed that a reduction of PM_{10} to a level of 20 µg/m³ was estimated to be associated with a reduction in acute mortality of 10.1 per 100,000 people per year, with a higher impact in summer than winter (Nawrot 2007). By using the APHEIS methodology, with 20 µg/m³ PM_{10} as a reference, we estimated that short term effects of air pollution on all cause mortality lead to 6.5, 8.6, and 11.2 deaths per 100,000 inhabitants per year, in Brussels, Antwerp and Liège, respectively. In other words the impact assessment of acute exposure to PM_{10} in the three cities is of the same order of magnitude than in the Flemish time-series analysis.

Belgium has no large cohort study that is followed up, as in The Netherlands (e.g. the Dutch cohort study or the Rotterdam study, Hoek et al. 2002). In such cohorts many life-style, social and environmentally factors can be linked with detrimental or beneficial health effects at an individual level to estimate the relevance at the level of the whole population. The APHEIS risk functions allow us to estimate the impact of chronic exposure for these Belgian cities. As expected from previous research the impact from chronic exposure to urban air pollution is more important than from acute exposure.

The exposure levels chosen as a reference greatly determine the obtained impact as showed in the figures. Here, we used the number of days where the values are above 20 µg/m³, or an annual mean of 20 µg/m³ to calculate the acute and chronic impact respectively.

This scenario corresponds to the proposed limit value for 2010 in the EU (1999/30/EC directive) and the WHO guideline value. By choosing a lower reference, e.g. 7.5 μg/m^3, as Künzli et al. (2000) did, the reported impact numbers will be increased by more than twice, as the effect of particulate air pollution on the studied end-points is believed to be linear.

Although the relative risks for dying of cardiovascular diseases is lower than of respiratory disease (for an increase of 10 μg/m^3 PM_{10} the cardiovascular and respiratory risk increases with 0.5% and 1.1%, respectively), the absolute number of deaths that could be prevented, if air pollution would be reduced to 20 μg/m^3, is much higher for cardiovascular diseases as compared with respiratory diseases (e.g. in Antwerp 27 vs. 13 cases per year). This is simply because the number of people which die from cardiovascular diseases is much higher (e.g. Antwerp: 2,154 vs. 720 cases per year).

Networks of measuring stations are not equally or spatially developed in the three studied cities. It consists in respectively six, two and three stations in Brussels, Liège and Antwerp. We used and compared measured or interpolated data as surrogates of individual exposure. Whether this might correctly reflects the exposure at the level of the individual is often discussed. The carbon content of lung macrophages is believed to reflect exposure to PM, particularly those arising from combustion process. We recently correlated, in 50 patients with diabetes, the carbon content of their lung macrophages with the six months averaged interpolated PM_{10} (4 by 4 km) and found a good correlation: r=0.38; p=0.01 (Jacobs et al. 2009). This adds to the evidence that the interpolated PM data are indeed representative of the exposure at an individual level. Consequently, it confirms and justifies the use of interpolated PM data.

Conclusions

The study showed that current levels of air pollution in Belgium have a non-negligible impact on public health. For the three cities combined, totaling 2 millions inhabitants, the number of preventable deaths linked to PM_{10} concentration levels above 20 μg/m^3 corresponds to an absolute numbers of 1,072 deaths. This figure is equal to 5.6% of the total mortality. Hence a reduction of PM_{10} concentrations to the proposed EU limit values would lead to a substantial health benefit for the population. Pollution should therefore be reduced and air quality and health need to be further monitored to better know the trends and consequences.

The experiment has shown that for the chosen year 2004, data were available and used successfully to perform the HIA. It also could be demonstrated that interpolated values can be used and that these results are in line with data from monitoring stations. This study has prepared three Belgian cities (Brussels, Liège and Antwerp) to join the international network of cities using the APHEIS methodology and to participate to its next developments. The NEHAP framework was successful in establishing a cooperation scheme to develop a network of cities to experiment HIA.

Acknowledgements

We thank all Belgian Public Services at Federal, Regional, Community level and the 36 local authorities that contribute to this study by providing demographic, health and air pollution data and by participating to the dissemination of adequate information to the citizens.

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TEMPORAL CHANGES OF CHEMICAL ACTIVITY IN THE ATMOSPHERE

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Introduction

The Network of the Russian Federal Service for Hydrometeorology and Environmental Monitoring (Roshydromet) includes 696 stations in 251 cities. In each city concentrations of 10 to 20 substances are determined. As follows from the observational data, urban air in Russia is polluted mostly by benz(a)pyrene, formaldehyde and nitrogen dioxide. The average concentration of these substances exceeds the maximum permissible values established in Russia. Between 2003 and 2007 the average concentrations of particulate matter have increased by 3.4%, nitrogen dioxide by 5.1%, ammonia by 7.1% and formaldehyde by 12.5%.

In the atmosphere a large number of photochemical processes occur under the influence of solar radiation. They promote transformation of some air pollutants into others and create new substances. These reactions can regulate and restore the composition of ambient air and even purify it. Among the pollutants contained in the ambient air of cities, formaldehyde and nitrogen dioxide are of particular interest. These pollutants are so-called "secondary" substances which are formed as a result of various photochemical reactions in the polluted atmosphere (Seinfeld 1997).

One indicator of these processes could be the transformation factor (TF) of NO_X to NO_2. TF represents the formation ratio of NO_2 to NO_X concentrations (Q) converted to ppb (Bezuglaya et al. 2008a).

$$TF = Q\ (NO_2)\ /\ Q\ (NO_X)$$

TF shows the ability of the atmosphere to accept the set quantity of pollutant by means of other chemical pollutants and produce a certain quantity of secondary substance. Otherwise it is possible, that TF shows which part of emissions in the atmosphere will be transformed to some new pollutants which will interact in photochemical reactions. Therefore TF „reports" the important information about the chemical activity of ambient air at a certain place. It expands our concept about the state of air pollution and explains the reasons of its temporal changes.

The increase in the degree of transformation means the increase of intensity of the chemical processes occurring in the atmosphere in general. This implies that not only transformations of NO_X to NO_2 can be intensified, but also consecutive reactions (Seinfeld 1997) of other pollutants, for example, formaldehyde.

Emissions of formaldehyde from industrial enterprises are often insignificant, but its concentrations measured in ambient air of cities can be significant (Figure 1). The number of Russian cities in which the mid-annual concentration of formaldehyde exceeds the 24-hour maximum concentration limit is increasing continually from year to year. The 24-h maximum concentration limit is 3 $\mu g/m^3$. As the analysis of observational data shows, formaldehyde is absent mostly in winter and essentially increases in summer due to rise in air temperature.

As an example, we will consider changes in atmospheric formaldehyde according to its concentration and air temperature in Beloyarsk. In this city at negative temperature the concentration of formaldehyde are low, but at higher temperature they sharply increase. The correlation factor between concentration of formaldehyde and air temperature is equal to 0.76. It is possible to draw a conclusion that the formation of formaldehyde is substantially connected with the photochemical reactions proceeding in the atmosphere. Thus, the higher the air temperature, the more intense are the reactions that lead to increasing formaldehyde concentrations.

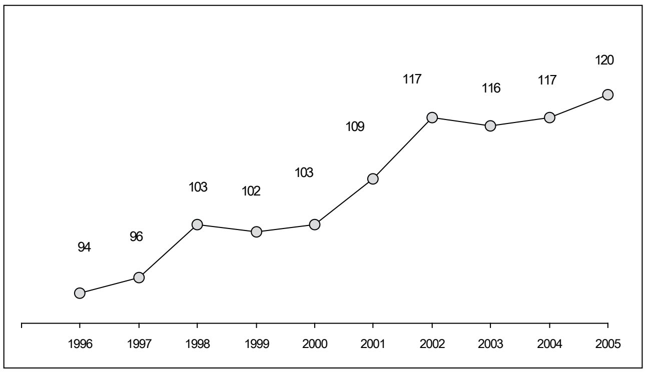

Figure 1: Number of cities in which mid-annual concentrations of formaldehyde exceed the 24-h maximum concentration limit (1996 to 2005)

Chemical activity changes under the influence of various factors, such as: quantitative and qualitative structure of the impurity of air, meteorological conditions in a district that define the clarification through precipitation scavenging, transportation and dissipation. Intensification or deceleration of these reactions in urban air can also be caused by temporal changes of air temperature and solar radiation.

This article describes the changes of the chemical activity in urban air for the recent 10 years on the basis of the given observational data of nitrogen oxide and nitrogen dioxide concentration at stations of the air quality monitoring network of Roshydromet (Bezuglaya et al. 2008a).

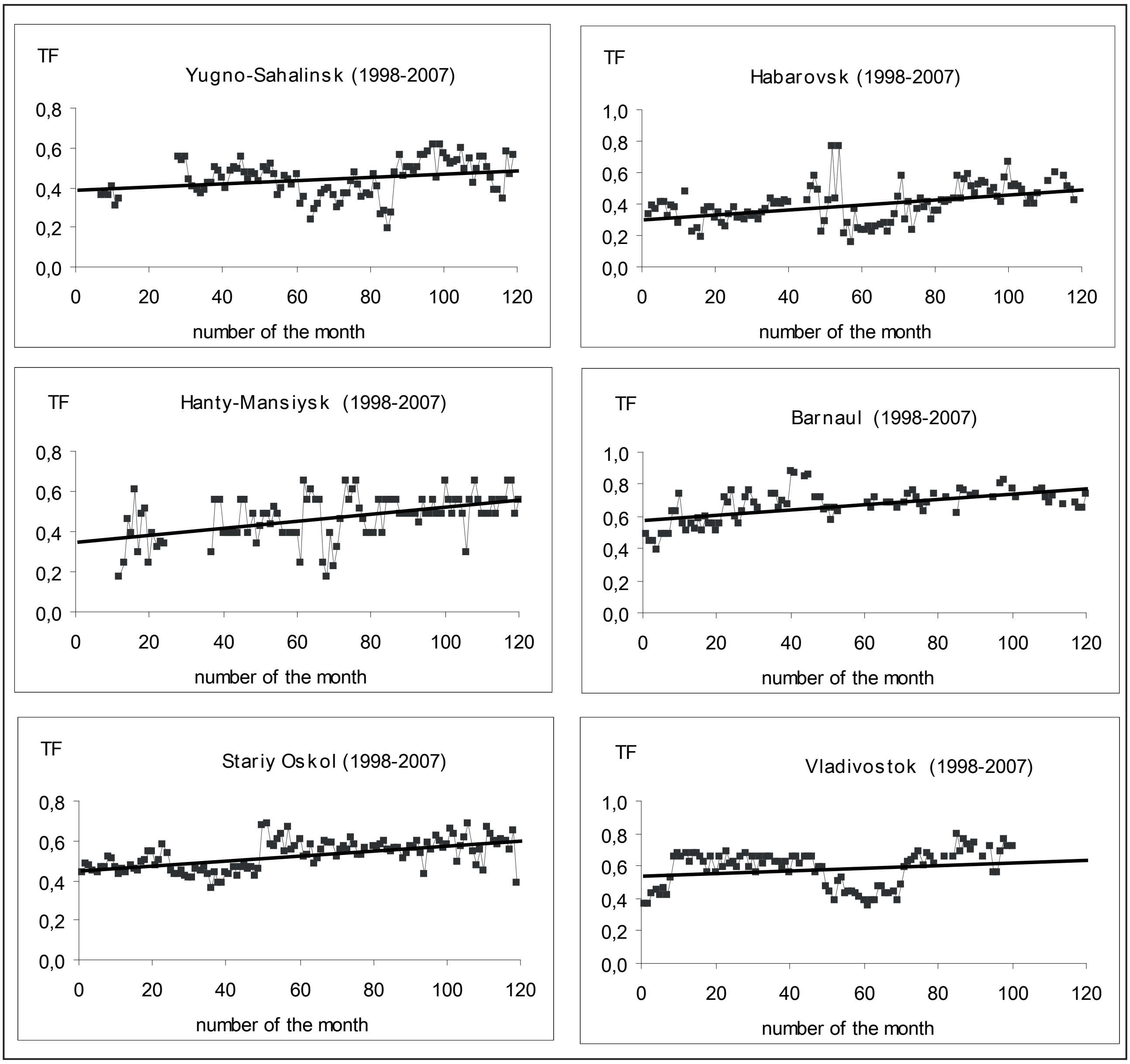

Figure 2: The tendency of TF changes in selected Russian cities

Data Description

The data of nitrogen oxide and nitrogen dioxide concentration for the time period between 1998 and 2007 in cities of various regions of Russia have been used for studying of temporal changing TF.

Simultaneous measurements of these pollutants have been used for these analyses of the same stations and periods of time in a number of cities with high concentration of these pollutants (more than 10 µg/m^3).

The total data of 18 cities, each with up to 120 monthly average values, were used to calculate the TF. These 18 cities are located in different regions and practically characterize all areas of the territory of Russia.

Selected Results

The number of cities where the average concentration of formaldehyde has exceeded the 24-h maximum limit value of 3 µg/m^3 (the Russian standard), has increased by 25% (Figure 1). The rise of the average concentration of formaldehyde is proved by the increase of TF value. All results of TF calculations show, that there is an increase of the TF in the last 10 years. This can be connected with the marked global warming and other changes of chemical compounds occurring in the atmosphere. Correlation factors between averages for monthly TF values changed during the time period in the range from 0.31 to 0.55. Some results of TF calculations are presented in Figure 2.

Generally, in 15 of 18 considered cities the transformation factor has increased. In the majority of cities the increase of TF was between 11 and 25% from a reference value, in Hanty-Mansiysk and Stariy Oskol it was up to 45% and in Habarovsk it has reached 60 to 66% (Bezuglaya et al. 2008b).

The increasing number of cities with average concentration of formaldehyde exceeding the 24-h maximum concentration limit and the calculated data on TF give the evidence that the photochemical reactions in the atmosphere had been intensified involving the occurrence of new portions of formaldehyde, nitrogen dioxide and other impurities.

This evidence broadens our knowledge about the chemical activity in the atmosphere. This circumstance allows assuming, that there can be also a strengthening of chemical activity in soil, waters of the rivers and lakes, and that, undoubtedly, will stimulate an increase of the cases of various harmful effects on human health.

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NOTES AND NEWS

Healthy Indoor Environments Protect Children's Health

Organized by the WHO Regional Office for Europe and hosted by the Ministry of Health of Luxembourg and the European Commission Public Health Directorate in Luxembourg, a Thematic Meeting on Healthy Environments took place in January 2009, which will strengthen the political resolve to address indoor environments as a European priority for the years to come. Preparing the Fifth Ministerial Conference on Environment and Health in February 2010 in Parma, Italy, the European policy-makers met to discuss and to derive recommendations for actions and policies to protect children's health from poor indoor air quality, obesity and injuries.

In particular, the financial crisis could lead to greater use of cheap heating fuels and burning of waste at home, in creasing risks to children's health in Europe too. Housing and the indoor environment affect health and well-being more than is commonly recognized, resulting in acute effects, ranging from sneezing and coughing to outcomes such as cancer, chronic respiratory disorders and fatal injuries. With young children spending up to 90% of their time indoors, this places them at exceptional risk. In the WHO European Region, 10,000 children aged 0 to 4 years are estimated to die each year from households' use of solid fuel, 90% of them in low- and middle-income countries. Owing to money or energy constraints, people burn waste or wood in rudimentary or badly maintained fireplaces for heating and cooking, instead of using cleaner but more expensive fuels. This increases exposure to carbon monoxide and the chances of house fires. For the poorest children in Europe, the risk of dying in accidental fires is almost 40 times that for the richest.

In some European countries, 20 to 30% of households have problems with damp, which increases the risk of respiratory disorders by 50%. Children are particularly susceptible; according to recent evidence, damp housing could account for 13% of childhood asthma in developed countries. Compact housing developments have higher concentrations of indoor pollutants, and promote damp. Where schools have limited air exchange rates, students' intellectual performance drops.

The WHO Regional Office for Europe is developing guidelines on this topic and recently reviewed examples of effective interventions, including adopting health-oriented building standards, providing financial incentives for switching to cleaner alternatives for heating and cooking, improving and maintaining indoor stoves, and quitting smoking. Healthy behaviour reduces disease and death; more determined action by citizens depends on the provision of scientifically sound and user-friendly information to parents and caregivers.

Transport Choices for Our Health and Environment

In January 2009 the Transport, Health and Environment Pan-European Programme (THE PEP) has been adopted the Amsterdam Declaration on 'Making THE link: Transport choices for our health, environment and prosperity'. The challenges posed by the current global financial crisis requires a proactive and integrated policy approach, and recognizing the significant role of investment in environment- and health-friendly transport in the creation of new economic and employment opportunities. The Minsters and Representatives of Member States of the UNECE and WHO European Region commit themselves to adopting integrated policies towards the attainment of the following four pan-European priority goals:

Priority Goal 1: to contribute to sustainable economic development and stimulate job creation through investment in environment- and health-friendly transport by directing investment towards the development of transport infrastructure that promote safety, environment and health and has the highest job creation potential, including rail and light rail; clean and efficient public transport, efficient intermodal connections; safety measures in road transport; and infrastructure for active and environmentally friendly transport.

Priority Goal 2: to manage sustainable mobility and promote a more efficient transport system by promoting mobility management schemes for businesses, schools, leisure activities, communities and cities, raising awareness of mobility choices by improving the coordination between land use and transport planning and promoting the use of information technology.

Priority Goal 3: to reduce emissions of transport-related greenhouse gases, air pollutants and noise by supporting a shift in the vehicle fleet towards zero- or low-emission vehicles and fuels based on renewable energy; promoting a shift towards clean transport modes and fostering electric mobility as well as eco-driving.

Priority Goal 4: to promote policies and action conducive to healthy and safe modes of transport by designing and modernizing urban areas and human settlements to improve the conditions for safe and physically active mobility, including infrastructure for walking and cycling, and efficient and accessible public transport, particularly focused on vulnerable groups such as children and persons with reduced mobility.

Besides, the ministers agree to achieve THE PEP priority goals by means on national transport, health and environment action plans (NTHEAPs). For further information, please see:

http://www.thepep.org

CITEAIR II has started

Going beyond the objective of CITEAIR I, this new project aims at exchanging excellence on air quality management and its synergies with climate change mitigation, as we as enhancing comparisons between cities and information to the public on air quality. Cities and regions all around Europe are facing exposure to high levels of air pollution and the emerging impacts of climate change, which have detrimental effects on their citizens and their economy.

Designing, implementing and monitoring mitigation measures is a tremendous challenge for policy makers and authorities, as is the need to raise public awareness. A wealth of knowledge and best-practices is available for cities and regions, which offers ample opportunities for collaboration. CITEAIR II aims to support local authorities by developing new tools and to facilitate the sharing of knowledge.

Building on the experience and users of a previous CITEAIR project (2004-2007, INTERREG IIIC), CITEAIR II aims to:

1. Provide up-to-date information on air quality in European cities to local and regional authorities, the public and the media and enhance the comparability of cities through the interactive website www.airqualitynow.eu and common air quality indices;

2. Identify, test and transfer good practice to describe the traffic situation and its impact on CO_2 emissions in urban areas by means of a mobility indicator;

3. Identify, test and transfer good practice to integrate greenhouse gases into existing air pollutant emission inventories for regulated pollutants and to select measures with a combined effect on reduction of urban pollutants and greenhouse gases;

4. Identify, test and transfer good practice for dedicated urban air quality forecasting addressing different levels of complexity that meet the needs of cities and regions depending on their local skills, resources and level of expertise.

In addition, CITEAIR II will establish an enhanced user community to assess the relevance of the good practices identified within the project and ensure their applicability elsewhere in Europe. CITEAIR II is therefore seeking the assistance of other European cities, regions and experts to cooperate in its activities.

For further information, please contact: info@citeair.eu

This article by Karine Léger (Airparif) was obtained from the new CITEAIR II Newsletter, No. 1, April 2009.

Inventory of Air Quality and Health Institutions in Europe Updated

Exchange of information is an essential part of cooperation, in particular at the international level. Since 2007, the WHO Collaborating Centre for Air Quality Management and Air Pollution Control assists with a current compilation of addresses and websites of national authorities and institutions dealing with air quality – both indoor and ambient air – and health in the 53 Member States of the WHO European Region. The compilation contains addresses, phone contacts and weblinks of governmental bodies, such as environmental and health ministries, authorities at sub-ordinate levels, and further institutions. About 250 weblinks are given which mostly provide direct links to sites on air quality and health information and/or data in English.

In some cases, information is available in the national language only. This guide is intended to assist those who would like to get into contact with authorities or institutions working in the field of air quality and health. Although the WHO Collaborating Centre has done the best in completing the search it is obvious that there can be no guarantee for completeness. It has been published in the WHO CC series “Air Hygiene Report”, Report 16.

Now an updated version (June 2009) is available at the WHO CC‘s website (Report 16, second edition):
http://www.umweltbundesamt.de/whocc/archiv/AHR16end.pdf

SIMAIR: A New Internet Tool to Evaluate Local Air Quality

A new computer-based tool has been developed in Sweden to help local authorities evaluate air pollution at street level. It allows the results to be compared easily with the EU air quality standards under the EU Air Quality Directive 2008/50/EC.

SIMAIR is a user-friendly, internet-based tool, designed for the road network throughout Sweden. It can assess concentration levels for fine particles (PM_{10}), nitrogen dioxide (NO_2), carbon monoxide (CO) and benzene. Local authorities can calculate total pollution levels for street sites and, within few seconds, receive a report which compares the simulated concentrations at the location with EU limit values. In addition, SIMAIR separates long range, urban and local (street) to total pollution levels. The SIMAIR system combines information from a number of models containing key details, including street and building layouts, climatic conditions, the type and flow of traffic, as well as emission data on the local, urban and regional scale. For further information contact:

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MEETINGS AND CONFERENCES

Exposure to Air Pollution and Effects on Human Health - A Meeting Report: 7th International Conference on Air Quality – Science and Applications 24 to 27 March 2009, Istanbul, Turkey

Introduction

The seventh International Conference on Air Quality – Science and Applications (formerly Urban Air Quality Conference) was organized by the Centre for Atmospheric Science and Instrumental Research (CAIR) at the University of Hertfordshire, U.K., and the Technical University of Istanbul, Turkey, jointly with COST 728, the American Meteorological Society, the World Meteorological Organization and the Air & Waste Management Association. The conference gathered approximately 260 delegates from 41 countries and from four continents.

Apart from health effects and human exposure, the topics of this very multi-disciplinary conference covered air quality policy and management, modelling, measurements, meteorological processes, climate interactions, emissions, and control measures in several parallel sessions. Health effects of and exposure to air pollution were mainly discussed in two special sessions of the conference, which included a total of 40 oral and poster presentations. These papers could be further clustered into four subtopics: (a) air quality guidelines and health indicators, (b) health impact and risk assessment, (c) exposure characterisation and source apportionment, (d) toxicological and epidemiological evidence. Although not exhaustive, the following paragraphs summarise some of the highlights of these two special sessions on air quality, human exposure and health.

Air quality guidelines and health indicators

Although the main emphasis in human exposure and health impact assessment studies has been on ambient air pollution levels, indoor air quality is causing increasing public health concern and gaining scientific interest. That was reflected on the development of indoor air quality guidelines by WHO presented in this conference and a substantial number of papers focusing on indoor exposure to particles and volatile organic compounds (VOCs). Two epidemiological studies from the U.S. (one time-series and one cohort study) were used as examples to highlight the need for more extensive air quality monitoring to resolve air quality-health issues. It was argued that epidemiological research is currently limited by the frequency of measurements and the number of pollutants monitored. In one of the examples, coarse zinc particles were associated with increased physician visits by asthmatic children, but due to the limited amount of monitoring data it was not clear whether this association was an artefact of the study or if zinc acted as a surrogate for some other pollutant.

A study from Germany (health weather project) focussed on the development of an integrated health index for pulmonary diseases, which is intended to enable citizens to take appropriate medication before or during air pollution episodes. The index is based on the combination of environmental satellite data, air quality modelling results and health data for the given population.

Health impact and risk assessment

Several papers on health impact and risk assessment were presented in the conference indicating the increasing popularity of these techniques. The studies covered a wide range of spatial scales, from local and urban, as illustrated in case studies from the U.K. (Birmingham), Estonia (Tallinn) and Belgium (Liège, Antwerp and Brussels), to national and continental scale, with case studies from Spain and Sweden. The Spanish study was based on the combination of emission (SMOKE), meteorological (WRF) and air quality (CMAQ) models and concentration-response relationships to provide estimates of averted deaths and hospital admissions due to atmospheric emissions reductions in the Iberian Peninsula. Issues associated with the relative importance of air quality and other health-related indicators (greenhouse gas emissions, traffic noise, road accidents, social deprivation, traffic accidents, etc.) were discussed in the Birmingham case study, while a study from Germany focused on the combined exposure to airborne particles and noise in urban areas. This study confirmed experimentally and using modelling that noise levels and primary emissions from road traffic correlate strongly, although the association between them varies with residential area type and vehicle fleet composition.

The use of intake fractions, i.e. the fraction of air emissions from a specific source eventually inhaled by the exposed population, was discussed as a screening technique for exposure assessment. A relevant case study from Helsinki (Finland) was used to illustrate the spatial, temporal and micro-environmental variability of intake fractions in an urban area.

Exposure characterisation and source apportionment

Although population exposure hotspots are currently mainly associated with road traffic emissions, the increasing popularity of wood burning for domestic heating in sub-urban areas may cause an additional challenge to the $PM_{2.5}$ emission control policies, as it was demonstrated by a number of studies from northern Europe.

A study from Finland assessed population exposure to $PM_{2.5}$ from road traffic and domestic wood burning using source-receptor matrices on two different grid resolutions. The use of coarser resolution (10 km) led to underestimations of population exposure (especially when related to road traffic), while a finer grid (1 km) provided more spatially accurate exposure estimates in densely populated areas. Another study from Finland presented an application of a probabilistic exposure model, which was used to estimate population exposure during selected air pollution episodes. This application highlighted the role of long-range atmospheric transport of pollutants on population exposure in Helsinki. An analysis of European population-based and seasonal studies on particle infiltration showed clear differences in the mean infiltration values between different geographical/climatological regions of Europe. Seasonality was also evident in the variation of occupant behaviour due to ambient temperatures and other environmental factors.

A study from France presented a modelling methodology for simulating the atmospheric transport of heavy metals (lead and cadmium) at continental and regional scale, as well as the transfer of contaminants in the air-soil-plant system. Another French study dealt with the characterisation of occupational exposure to pesticides using a variety of sampling techniques as well as urinary bio monitoring.

The effect of exposure to carcinogenic polycyclic aromatic hydrocarbons (c-PAHs) adsorbed onto respirable particles ($PM_{2.5}$) on DNA adducts and chromosomal aberrations was studied in groups of policemen and bus drivers in Prague (Czech Republic). This study concluded that DNA adducts in the lymphocytes of subjects exposed to c-PAH are an appropriate biomarker of the biologically effective dose.

Two studies, one from Italy and one from Spain, focused on the occurrence of cocaine and other illegal drugs in the air of several cities, highlighting the need for more extensive monitoring studies for assessing environmental and health safety. Researchers from three European countries compared emission sources and factors influencing PM_{10} and $PM_{2.5}$ levels in Athens, Madrid and London, providing insights into population exposure and effective pollution control measures. Other studies presented in this meeting focused on the characterisation of indoor and/or personal exposure in schools, residential and transient (e.g. commuter) microenvironments in Europe and elsewhere.

Epidemiological and toxicological evidence

An epidemiological study on a Chinese population from Beijing focused on the short-term effects of submicron particles on respiratory mortality. The analysis, based on Poisson distributed lag models, indicated that after controlling for season and meteorological parameters, significant associations were observed between daily respiratory mortality and particle number concentrations in different size ranges. It was reported that health effects associated with particles smaller than 50 nm were delayed for two or three days, whereas particles larger than 50 nm showed immediate effects.

An Italian study demonstrated strong associations between air pollution levels and health effects using an artificial neural network (ANN) model to handle the non-linear relationship and inclusion of meteorological variables. The ANN model performed better than the traditional multiple regression based model. A similar study from Greece used multivariate stepwise analyses and ANNs to investigate the relationships between air pollution, meteorology and hospital admissions in Athens. Both techniques revealed that elevated particulate matter concentrations were the dominant parameter related to hospital admissions, followed by O_3 and other pollutants such as CO, NO_2 and SO_2. Furthermore, changes in daily hospital admissions were related to specific meteorological conditions that influenced the accumulation of pollutants in urban areas. Comparison of the two models revealed that the application of ANN in complex urban environments may provide improved modelling results compared to regression modelling.

It was pointed out that current risk assessment methodologies tackle atmospheric pollutants as single substances associated with individual health endpoints, while in reality people are exposed to mixtures of chemicals present in the environment. A study from the Institute for Health and Consumer Protection (JRC) presented a pharmacokinetic/pharmacodynamic model for benzene, toluene, ethylbenzene and xylenes that accounts for the interactions among these chemicals at different sites of human metabolism. This study showed that combined lifelong exposure to all four VOCs, even at low doses, can modify the health risk estimates compared to considering exposure to each substance individually. This would call for a revisit of current risk assessment methodologies to address the so-called "cocktail effect".

Last but not least, an experimental study from the U.K. focused on the toxicological mechanism of damage of nanoparticles in the human lung, using different types of atmospheric and engineered nanoparticles, and key components of the lung fluid in vitro.

Conclusions

Although there have been significant improvements in air quality in the last two decades mainly in developed countries, air pollution is still an issue of public health concern in many parts of the world. Air quality monitoring and modelling techniques can help characterise population exposure and provide data inputs to epidemiological studies. Apart from widely used dispersion modelling, ambient monitoring, and classical epidemiological analysis techniques, certain targeted exposure modelling, micro-environmental monitoring and statistical analysis (e.g. artificial neural network) methodologies were presented in this conference.

Several modelling studies demonstrated that the spatial resolution of air quality modelling has a pronounced effect on population-weighted exposure levels based on residence location. However, it was pointed out that since most people do not spend all their time at home, continuous refinement of the spatial resolution of air quality modelling results does not warrant improved population exposure estimates. Furthermore, it was felt in this meeting that population mobility and behavioural aspects need to be incorporated in exposure models in order to achieve improved simulations.

There is certain evidence that the biological mechanism whereby respirable particles of different sizes cause harm to human health could be different and need further investigation. Furthermore, it was suggested that identification of the particulate matter fraction responsible for toxicity is critical for designing effective emission reduction policies, while the assumption that all constituents of fine particles are equally toxic may lead to a focus on reducing secondary particulate precursor emissions, which would probably deliver little health benefit.

Emerging health protection issues such as the impacts of respirable particles from wood burning, the mechanism of toxicity of nanoparticles, and the combined effects of mixtures of pollutants (e.g. VOCs) were discussed in the meeting. In particular, it was pointed out that wood burning for domestic heating is gaining popularity as a renewable energy source in developed countries, causing an increase in primary emissions of fine particles in urban and sub-urban areas. The health effect assessment of engineered nanoparticles and complex pollutant mixtures clearly require further research. Finally, health impact assessment techniques seem to gain popularity within the air quality research community, creating a forum for interaction between air quality modellers, epidemiologists, toxicologists, risk analysis experts and environmental health professionals.

Full proceedings from the 7th International Conference on Air Quality – Science and Applications are available though its organisers: http://www.airqualityconference.org.

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PUBLICATIONS

WHO

Addressing the Socioeconomic Safety Divide: A Policy Briefing

L. Laflamme, D. Sethi, S. Burrows, M. Hasselberg, F. Racioppi and F. Apfel, Who Regional Office for Europe 2009, 38 pages, ISBN 978 92 890 4300 7, available through the web: http://www.euro.who.int/document/e92197.pdf.

This policy briefing summarizes evidence on the socioeconomic safety divide from a large systematic review: Socioeconomic differences in injury risks. A review of findings and a discussion of potential countermeasures. It provides messages for policy-makers, researchers and public health advocates and safety planners on what can be done to address this safety divide.

Action needs to be intersectoral; governments need to aim for equity across all types of government policies; and action needs to be taken both to make the social and physical environment safer generally and to target disadvantaged populations.

City Leadership for Health - Summary Evaluation of Phase IV of the WHO European Healthy Cities Network

G.Green and A. Tsouros, WHO Regional Office for Europe 2008, 28 pages, ISBN 978 92 890 4287 1, available through the web: http://www.euro.who.int/document/E91886.pdf.

This summary evaluation of Phase IV of the WHO European Healthy Cities Network reviews the organization of healthy cities, their enduring values and their work on the core themes of health impact assessment, healthy ageing, healthy urban planning and active living. It gives 23 messages for city decision-makers and the international public health community.

OTHERS

The Evaluation of the Intercomparison Exercise for SO_2, CO, O_3, NO and NO_2 carried out in October 2007 in Essen

M.K. Dukarić, A. Borowiak, F. Lagler and M. Gerboles, Scientific and Technical Report, EC Joint Research Centre, Institute for Environment and Sustainability, Ispra, Italy 2009, 58 pages, ISBN 978 92 79 12008 4 / EUR 23788 EN.

In October 2007 in Essen, Germany, 13 AQUILA and 5 WHO-EURO laboratories met at intercomparison exercise to evaluate their proficiency in the analysis of inorganic gaseous pollutants covered by European Air Quality Directives (SO_2, CO, O_3, NO and NO_2). The proficiency evaluation, where each participant's bias was compared to two criteria, provides information on current situation to European Commission and can be used by participants in their QA/QC.

In terms of criteria imposed by European Commission, 65% of results reported by AQUILA laboratories were good both in terms of measured values and reported uncertainties while another 32% of results had good measured values but the reported uncertainties were either to small or too big (27%). The comparability of results among AQUILA participants is satifactory for O_3, SO_2, CO, and NO measurementmethod but not for NO_2 where further harmonization is needed.

Reporting on Ambient Air Quality Assessment - Preliminary Results for 2007

F. de Leeuw and E. Vixseboxse, Technical Paper 2008/4, ETC/ACC Bilthoven, The Netherlands 2008, 27 pages, available through the web: http://air-climate.eionet.europa.eu/docs/ETCACC_TP_2008_4_prelim_analysis_AQQ2007.pdf.

EU Member States have submitted annual reports on air quality in 2007 to the European Commission under the Air Quality Framework Directive (96/62/EC). The reports were provided in the form of a predefined questionnaire. The present report gives a preliminary overview and analysis of the submitted information.

Health Impacts and Air Pollution

K. Barrett et al., Technical Paper, ETC/ACC Bilthoven, The Netherlands 2008/13, 48 pages, available via the web: http://air-climate.eionet.europa.eu/docs/ETCACC_TP_2008_13.

The great diversity of environments and lifestyles across Europe poses a challenge when it comes to estimating Europe-wide consequences of air quality upon the population. The size of communities, the nature of economic activity, the pollutant of concern, the geographical location and more will all influence the effect air quality may have upon human health. Yet to date, estimations of health impact for the whole continent has utilised a restricted spatial resolution of air quality variability and simplified estimates of population distributions. The challenge is to identify the main factors which will modify current estimates, to quantify the magnitude of such modifications, and to estimate the resolution needed to appropriately accommodate this diversity. This report addresses the following aspects: the spatial scale of assessment, the influence of meteorological differences at street level, the influence of daily intra-urban migration on exposure to air pollution, the comparative health effects of finer particulate air pollution, and the statistical description of the impact of particulates and of ozone.

Through case studies in Silesia, Athens, London and Oslo the report begins to contribute depth to our understanding of the impact of air quality upon health across Europe's various environments. Assessment at a finer spatial resolution is shown to increase the estimates of total exposure experienced by a population. Improving temporal resolution improves our use of spatial information through description of intra-urban temporal population movement. Estimated total exposure increases.

When Europe-wide estimates are made, the numbers of total estimated premature deaths from exposure to $PM_{2.5}$ approximates those already estimated to result from exposure to PM_{10}. Indeed, it is found that for 10 Member States the Average Exposure Index lies above the 2015 binding value of 20 µg/m^3, in 5 Member States it lies at or slightly below this level, whilst for 12 Member States the average exposure index is clearly below.

Air Quality and Ecological Impacts, 9

A. Legge, Elsevier Publications 2009, 320 pages, ISBN: 978 0 08 095201 7, € 135,-.

Source apportionment is the estimation of the contributions to the airborne concentrations that arise from the emissions of natural and anthropogenic sources. To obtain a source apportionment, data analysis tools called receptor models are applied to elicit information on the sources of air pollutants from the measured constituent concentrations. Typically, they use the chemical composition data for airborne particulate matter samples. In such cases, the outcome is the identification of the pollution source types and estimates of the contribution of each source type to the observed concentrations. It can also involve efforts to identify the locations of the sources through the use of ensembles of air parcel back trajectories. In recent years, there have been improvements in the factor analysis methods that are applied in receptor modeling, as well as easier application of trajectory methods. These developments are reviewed and typical applications to data from national parks, wilderness, and other Class 1 visibility locations in the United States are presented in this chapter.

Spatial Assessment of PM_{10} and Ozone Concentrations in Europe (2005) – EEA Technical Report No 1/2009

J. Horálek, J. Fiala, P. Kurfürst (CHMI), B. Denby (NILU), P. de Smet, F. de Leeuw (PBL), published by EEA, Copenhagen, Denmark 2009, 54 pages, ISBN 978 92 9167 988 1, available through the web: http://www.eea.europa.eu/publications/spatial-assessment-of-pm10-and-ozone-concentrations-in-europe-2005-1/at_download/file.

This report presents particulate matter (PM_{10}) and ground level ozone concentration maps covering the whole of Europe. The interpolated maps are based on a combination of measurement and regional modelling results. Using measured concentrations as a primary source of information, the report summarizes the methodologies and the methodological choices taken in order to derive such maps. The maps use monitoring data for 2005 as a basis, i.e. values reported by the EEA member countries in 2006 under the Exchange of Information Decision (EC 1997). To estimate people's exposure to PM_{10} and ozone concentrations and possible health impacts, measurement data in denser populated areas have got a higher weight than those in less populated regions. Additionally, the study considers the WHO human health indicator SOMO35 and the vegetation related indicator AOT40 for vegetation/crops or forests. Both metrics, the SOMO35 and the AOT40, are measures of the accumulated exposure of humans or vegetation to high ozone levels over a certain period.

Jahresbericht der Luftgütemessungen in Österreich 2007

W. Spangl, C. Nagl, L. Moosmann., Umweltbundesamt Wien, Österreich 2008, 202 pages, ISBN 3 85457 950 0, available through the web: http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0153.pdf.

Luftgütemessungen und meteorologische Messungen des Umweltbundesamtes - Jahresbericht 2007

W. Spangl, C. Nagl, L. Moosmann., Umweltbundesamt Wien, Österreich 2008,108 pages, ISBN 3 85457 951 9, available through the web: http://www.umweltbundesamt.at/fileadmin/site/publikationen/REP0154.pdf.

COMING EVENTS

2009

July 2009

Air Pollution 2009 – 17th International Conference on Modelling, Monitoring and Management of Air Pollution
20-22 July, Tallinn, Estonia. For more information, see: http://www2.wessex.ac.uk/09-conferences/air-pollution-2009.html.

August 2009

21st Conference of the International Society for Environmental Epidemiology (ISEE) – Food and Global Health
25-28 August, Dublin, Ireland.
For more information, see: http://www.isee2009.ie.

September 2009

Healthy Buildings 2009
13-17 September, New York, USA.
For more information, see: http://hb2009.org/.

Measuring Air Pollutants by Diffuse Sampling and Other Low Cost Techniques
15-17 September, Krakow, Poland.
For more information, see: www.aamg-rsc.org.

Environmental Health Risk – Fifth International Conference on the Impact of Environmental Factors on Health
21-23 September, New Forest, United Kingdom.
For more information, see:
http://www2.wessex.ac.uk/ehr2009rem1.html.

October 2009

FINE! Dust-Free
1-2 October, Klagenfurth/Lake Woerthersee, Austria. For more information, see: www.life-spas.at.

HIA09 – 10th Annual Conference on Health Impact Assessment
14-16 October, Rotterdam, The Netherlands.
For more information, see: www.hia09.nl.

2010

March 2010

Climate Change – Global Risks, Challenges and Decisions
10-12 March, Copenhagen, Denmark. For more information, see: http://climatecongress.ku.dk.

April 2010

Sustainable City 2010 – Sixth International Conference on Urban Regeneration and Sustainability
14-16 April, La Coruña, Spain. For more information, see: http://www.wessex.ac.uk/city2010rem1.html.

June 2010

Air Pollution 2010 – 18th International Conference on Modelling, Monitoring and Management of Air Pollution
21-23 June, Kos, Greece. For more information, see: http://www.wessex.ac.uk/air2010cfp.html.

Forest Fires 2010 –
Second Int. Conference on Modelling, Monitoring and Management Forest Fires
23-25 June, Kos, Greece. For more information, see: http://www.wessex.ac.uk/fires2010cfp.html.

September 2010

15th World Clean Air and Environmental Protection Congress
12-16 September, Vancouver, Canada.
More information will be available soon at: http://iuappa.com/index.htm.

Oktober 2010

Fourth Central and Eastern European Conference on Health and the Environment
10-13 October, Prague, Czech Republic.
For more information, see: www.ceeche.org.

EDITORS' NOTE

We appreciate submissions to NOTES AND NEWS regarding programmes and projects within the field. Notes (100-500 words) should be sent directly to the WHO Collaborating Centre for Air Quality Management and Air Pollution Control.

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www.umweltbundesamt.de/whocc/titel/titel21.htm