NEWSLETTER

WHO COLLABORATING CENTRE FOR AIR QUALITY MANAGEMENT AND AIR POLLUTION CONTROL

at the

FEDERAL ENVIRONMENTAL AGENCY
GERMANY

No. 33 June 2004

CONTENTS

Health Aspects of Air Pollution - Summary of Main Findings of the WHO Project 'Systematic Review of Health Aspects of Air Pollution in Europe'	2
The EMECAM/EMECAS Project - A Spanish Multicentre Study on Health Effects of Air Pollution	8
Notes and News	15
Meetings and Conferences	17
Publications	21
Coming Events	23

HEALTH ASPECTS OF AIR POLLUTION
SUMMARY OF MAIN FINDINGS OF THE WHO PROJECT 'SYSTEMATIC REVIEW OF HEALTH ASPECTS OF AIR POLLUTION IN EUROPE'

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Air pollution affects the health of European citizens

Effects of various air pollutants on human health have been well documented in Europe and other parts of the world. Concerns about these health effects and also effects on the environment have led to the implementation of regulations to decrease the emissions of harmful air pollutants or their precursors and the establishment of air quality standards on the international (e.g., European Union Directives on ambient air quality; on emission sources and products), national, regional and local level. Additional measures – while necessary to further reduce the health effects caused by air pollution - are becoming increasingly expensive. As a consequence, there is a growing need for accurate, science-based information on the impact of air pollution on health as a basis for designing effective and well-targeted strategies to reduce these adverse impacts.

The Clean Air for Europe (CAFE) programme

The 6th Environment Action Programme (6th EAP 2001-2010, 'Environment 2010: Our Future, Our Choice') sets out the key environmental objectives to be attained in the European Community in the coming years. One of the objectives of the 6th EAP is to establish a high level of quality of life and social well-being for citizens by providing an environment where the level of (air) pollution does not give rise to harmful effects on human health and the environment. The activities of the European Commission to implement the 6th EAP are currently taking place within the Clean Air for Europe (CAFE) programme (http://europa.eu.int/comm/environment/air/cafe/index.htm). CAFE will lead to the adoption of a thematic strategy on air pollution under the 6th EAP. CAFE aims to develop a long-term, strategic and integrated policy advice to protect against significant negative effects of air pollution on human health and the environment.

WHO support for CAFE

The World Health Organization (WHO) project "Systematic Review of Health Aspects of Air Quality in Europe" ('*Systematic Review*'), implemented by the WHO European Centre for Environment and Health (WHO/ECEH), Bonn Office, Germany, aimed to provide the CAFE programme with a systematic, periodic, scientifically independent review of the health aspects of air pollution in Europe (http://www.euro.who.int/eprise/main/WHO/Progs/AIQ/Activities/20020530_1).
The project was implemented from late 2001 until mid 2004. As part of the project, the following reports were produced:

- Health aspects of air pollution with particulate matter, ozone and nitrogen dioxide
- Meta analysis of time-series studies and panel studies of particulate matter and ozone
- Health aspects of air pollution – answers to follow up questions from CAFE
- Impact of air pollution on children's health (to be published mid 2004)
- Health effects of air pollution (a summary brochure).

All reports can be obtained as printed version from WHO and may be downloaded from the WHO page: http://www.euro.who.int/air.

A Scientific Advisory Committee (SAC), consisting of ten notable and independent experts in the field of air pollution and health, was established in 2001 by WHO/ECEH to guide this review project. The review of evidence was performed according to well-defined procedures. After drafting text based on state-of-the-art science, much emphasis was laid on an external review process. Up to 40 experts were invited to review the drafts carefully and critically. Subsequently, working group meetings were held to discuss the issues and to agree on the conclusions in consensus before they were published.

Focus on PM, ozone and NO_2

Ambient air pollution consists of a highly variable, complex mixture of different substances, which may occur in the gas, liquid and solid phase. Several hundred different components have been found in the troposphere, many of them potentially harmful to human health and the environment. Nevertheless, the S*ystematic Review* focused on three pollutants: particulate matter (PM), ozone (O_3) and nitrogen dioxide (NO_2). This is not to imply that other substances do not pose a considerable threat to human health and the environment at levels present in Europe nowadays. However, the effects of other substances have either been reviewed recently, or the conclusions from the WHO Air Quality Guidelines for Europe (WHO, 2000) were regarded as generally still valid.

Decreasing pollutant levels will have health benefits

The body of evidence on health effects of air pollution at levels currently common in Europe has strengthened considerably over the past few years. Both epidemiological and toxicological evidence have contributed to this strengthening. The latter provides new insights into possible mechanisms for the hazardous effects of air pollutants on human health and complements the large body of epidemiological evidence, which, e.g. shows consistently associations between the daily variations of air pollution and certain health outcomes. One of the crucial questions - for the scientific community and policy makers – is whether these associations are causal and if yes, which agent(s) involved in the air pollution mixture are crucial for the effects. Only if the relationships are causal, it can be assumed that a reduction of air pollution will reduce health impacts. The results of this review strongly suggest that it is indeed reasonable to assume that a further reduction of air pollution in particular with PM and ozone will lead indeed to health benefits. This is also in line with recent ‘intervention studies’ which could demonstrate health benefits following the reduction of pollution levels under different circumstances.

The elderly, children and individuals with underlying disease are potentially at high risk

A number of groups within the population have potentially increased vulnerability to the effects of exposure to air pollutants. Very young children and unborn babies seem particularly sensitive to some pollutants. Groups, which develop increased sensitivity include the aged, those with cardio-respiratory disease or diabetes, those who are exposed to other toxic materials that add to or interact with air pollutants and those who are socio-economically deprived.

No thresholds for PM and ozone

Traditionally, the concept of no-effects thresholds has played an important role in formulating air quality policies and in deriving air quality standards. The existence of such thresholds implies no effects until a “threshold” concentration is crossed; then risk rises (a ‘hockey stick’ shaped concentration response function). In principle, thresholds are an appealing concept. However, epidemiological studies investigating large populations have been unable to consistently establish such threshold levels for health effects in these populations, in particular for PM and ozone. These findings also imply that the current WHO Air Quality Guideline for ozone of 120 $\mu g/m^3$ as eight-hour mean value does not represent a level below which no adverse effects might be expected. Consequently, the threshold concept might be elusive for these pollutants. This is most probably at least partly a consequence of the inevitably large heterogeneity of individual susceptibilities present in large populations (see also paragraph above). Instead of thresholds, exposure/concentration – response relationships for various health endpoints provide more realistic information for designing effective strategies to reduce adverse effects on human health.

The current EU limit/target values for PM and ozone do not provide sufficient protection to public health

As stated, no clear no-effect threshold could be derived for PM and ozone. Therefore, even if the limit value/target value is achieved, significant health impacts including a marked reduction in life expectancy are expected due to the remaining exposure. Vice versa, health benefits will accrue from a reduction in pollutant concentrations below the current standards.

$PM_{2.5}$ is an appropriate indicator to characterise air pollution with particulate matter

The S*ystematic Review* project extensively assessed the evidence on health effects of air pollution with PM on health and recommended the use of fine particulate matter ($PM_{2.5}$) as indicator for health effects such as reduction of life expectancy induced by (long-term) exposure to particulate pollution. However, some health effects are also linked to the coarse fraction (particles with an aerodynamic diameter between 2.5 and 10 µm). Therefore, there is sufficient concern about the health effects of coarse particles to justify their control.

Primary combustion aerosols are of special concern

Air pollution with PM may result from a number of different emission sources. It would be important to know if PM from certain sources or of certain composition gives rise to special concern from a health perspective, e.g., due to high toxicity. However, only few epidemiological studies have addressed this important question specifically. These studies have suggested that combustion sources are particularly important for health effects. Toxicology studies have also highlighted the primary, combustion-derived particles having a high toxic potency. Despite the differences in toxicological potency among constituents under laboratory conditions, it is currently not possible to precisely quantify the contributions from different sources and different PM components to health effects from exposure to ambient PM. However, it seems reasonable to include those sources/constituents, which have been identified as critical by toxicology, in abatement efforts.

Annual guideline is recommended for PM, supplemented by daily value

The *Systematic Review* confirmed that public health significance of the long-term effects from exposure to PM clearly outweighs the public health significance of the short-term effects. However, effects of short-term exposure to PM have been documented in numerous time-series studies (these are studies which link the daily variations in air pollution to specific health endpoints like hospital admissions or mortality), many of them conducted in Europe, indicating large numbers of, e.g., attributable deaths and cardiovascular and respiratory hospital admissions. Therefore, short-term (24 hours) as well as long-term (annual average) guidelines are recommended.

Ozone: peaks are important, but levels also have to be reduced during the whole (summer) season

Time-series studies have demonstrated linear or near-linear relationships between day-to-day variations in peak ozone levels and health endpoints down to low concentrations. As there are usually many more days with mildly elevated concentrations than days with very high ozone levels, the largest burden on public health may be expected with the many days with mildly elevated concentrations, and not with the few days with very high concentrations. Consequently, abatement policies should not only focus on few days with high peak ozone concentrations, but should aim to reduce ozone levels during the whole summer season.

Eight hours is preferred averaging time for ozone guideline

For short-term exposure, it is clear that the effects increase over multiple hours (e.g., 6-8 hours for respiratory function effects and lung inflammation). Thus, an 8-hour averaging time is preferable. The relationship between long-term O_3 exposure and health effects is not yet sufficiently understood to allow for establishing a long-term guideline.

The WHO Air Quality Guideline value for NO_2 of 40 µg/m^3 as annual mean should be retained or lowered

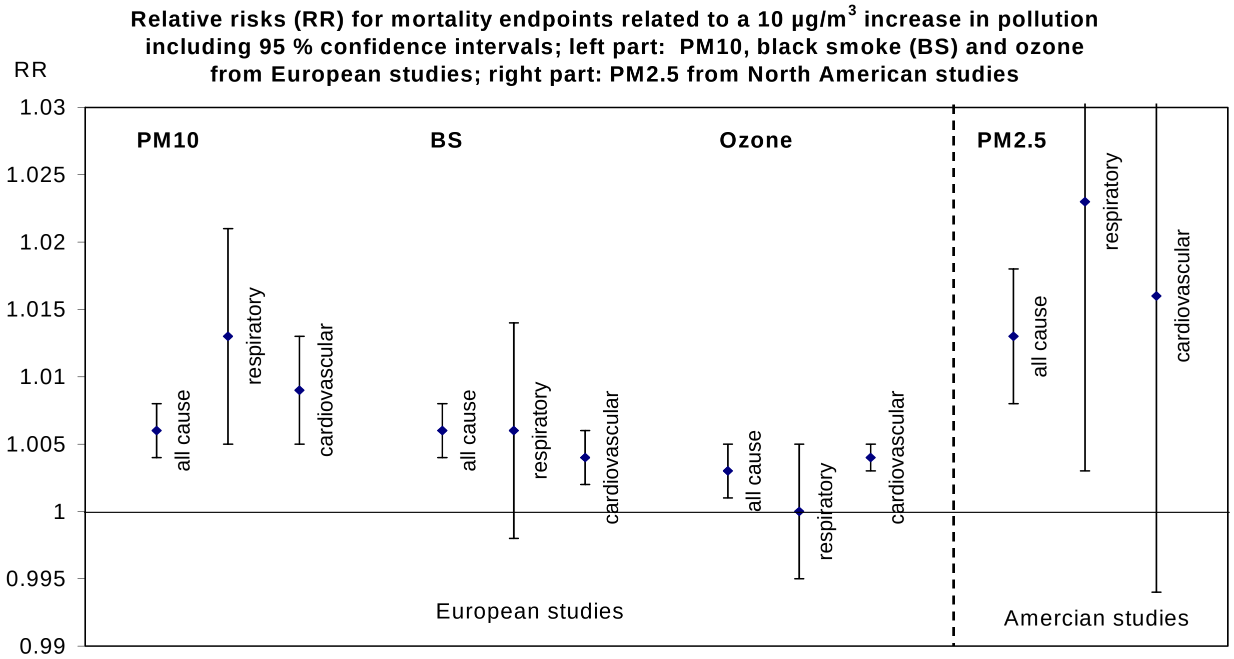
The *Systematic Review* closely reviewed the scientific evidence in support of the current WHO Air Quality Guideline value for NO_2 of 40 µg/m^3 as annual mean. This value is of considerable practical importance since it has been transformed into a binding air quality limit value in EU legislation (Directive 1999/30/EC). The review acknowledged that uncertainty remains over the significance of NO_2 as a pollutant with a direct impact on human health at current ambient air concentrations in the European Union, and that there is still no firm basis for selecting a particular *concentration* as a long-term guideline for NO_2. However, in recent epidemiological studies of the effects of combustion-related (mainly traffic generated) air pollution, NO_2 has been associated with adverse health effects even when the annual average NO_2 concentration is within a range that includes 40 µg/m^3, the current guideline value. Therefore, it was recommended that the WHO guideline value of 40 µg/m^3 as annual mean should be retained or lowered.

Concentration-response functions for ozone and PM – acute effects

Quantitative health impact assessment has become increasingly important in the development of air quality policy. For such analysis it is important to have accurate information on the concentration response relationships for the effects investigated, i.e. on the relationship between levels of air pollution and its impact on health. Therefore, a quantitative meta-analysis of peer-reviewed European studies was conducted to obtain summary estimates for certain air pollutants and health effects. The data for these analyses came from a database of time-series studies developed at St. George’s Hospital Medical School at the University of London. Updated risk coefficients in relation to ambient exposure to particulate matter and ozone were obtained for all-cause and cause-specific mortality and hospital admissions for respiratory and cardiovascular causes. Some results are shown in the following figure (there were not enough European results for a meta-analysis of effects of $PM_{2.5}$; the relative risks (RR) for this pollutant are from North American studies and are shown for illustrative purpose only). The meta-analysis also included an assessment of possible publication bias. For several pollutant/health outcome pairs, there was indeed evidence for publication bias. For these outcomes, revised summary estimates were calculated using special statistical techniques. However, the overall conclusions remained unaltered - that there are statistically significant associations between some air pollution indicators and daily mortality and morbidity.

Further action is needed

The findings of this review on the effects of PM and ozone on mortality clearly demonstrate that further policy action is needed to reduce levels of air pollutants in Europe.



No concrete proposal for a numerical value of a limit value for PM and ozone at this stage

WHO Air Quality Guidelines values have been used previously to directly derive legally binding air quality standards. E.g., the guideline values for NO_2 of 200 µg/m^3 as one-hour mean and of 40 µg/m^3 as annual mean have been translated into EU legislation. The process of deriving limit values (or other air pollution related objectives) is often more complex for pollutants without no-effect-thresholds. In such cases a reduction of exposure to levels as low as possible would be desirable from the health point of view. However, it has to be acknowledged that other considerations have to be taken into account like current pollution levels, natural background concentrations, attainability and cost-effectiveness and cost-benefits. The latter points are not covered by the *Systematic Review* project, but are considered in an 'integrated assessment' as part of the development of the thematic strategies within CAFE. Therefore, the *Systematic Review* project did not propose a concrete numerical value of a limit value for PM or ozone at this stage, but rather provided health-related information for the process of integrated assessment.

Health endpoints for integrated assessment within CAFE

Integrated assessment is a tool to identify cost-effective emission reduction strategies to achieve certain environmental objectives. These environmental objectives may be related to effects on ecosystems (e.g., protection against acidification) or impacts on human health. Integrated assessment modeling performed by IIASA (International Institute for Applied System Analysis) using the RAINS model (http://www.iiasa.ac.at/rains/index.html) has played a crucial part in identifying cost effective emission reduction strategies on a European scale. IIASA has in close collaboration with WHO expanded the RAINS model since then to cover also mortality due to long-term exposure to PM. In addition, a formulation to include ozone-related mortality into RAINS was agreed upon, taking into account the findings of the *Systematic Review* project.

Focus on urban background and 'hotspots'

Current EU legislation requires air quality assessment (and management, if certain pollution levels are exceeded) both in areas where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value and in areas which are representative of the exposure of the general population. The *Systematic Review* confirmed the validity of such an approach. A policy which aims at a significant reduction of the overall health burden caused by air pollution will have to aim at a reduction of the exposure of the general population. This is in particular true for pollutants/health endpoints with (a) no threshold of effects and (b) a linear relationship between exposure and response. However, some studies have documented that subjects living close to busy roads experience more short-term and long-term effects of air pollution than subjects living further away. The public health burden of exposures at hot spots (e.g., near major roads) may therefore be significant, and regulatory efforts should not exclude those areas. WHO also notes that an unequal distribution of health risks over the population raises concerns of environmental justice and equity.

Research on air pollution and health

Even though the evidence on the relationship between exposure to different air pollutants and health effects has increased dramatically over the past few years, there are still large uncertainties and considerable gaps in knowledge. These gaps can only be reduced by targeted scientific research. Areas where such research is urgently needed include: exposure assessment; dosimetry; toxicity of different components; mechanisms of injury; susceptible groups; effects of mixtures versus single substances, etc.

The WHO Air Quality Guidelines for PM and ozone will be updated

The review made a clear recommendation to update the current WHO Air Quality Guidelines, in particular for particulate matter and ozone to take account of the most recent scientific findings. Therefore, WHO has launched the formal process of updating its Air Quality Guidelines. An updated version may be expected for 2005/2006.

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THE EMECAM/EMECAS PROJECT A SPANISH MULTICENTRE STUDY ON HEALTH EFFECTS OF AIR POLLUTION

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Introduction

In the last years, a substantial number of epidemiological studies indicate a link between air pollution and health. An important number of time-series studies have shown associations with mortality, for emergency and hospital admissions for respiratory and cardiovascular diseases, and for other health indicators. Besides that, experimental studies are adding evidence to the potential mechanisms for that link. In these years several multicenter studies have been carried out in different regions of the world accounting for the situation in groups of cities, such as the APHEA study in Europe (Katsouyanni et al., 2001) and the National Mortality, Morbidity and Air Pollution Study (NMMAPS) in the United States (Samet et al., 2000), or European national projects such as 'Air Santé' in France (Quenel et al., 1999) or the Italian Meta-analysis on Health and Air Pollution (MISA) in Italy (Biggeri et al., 2001).

Within this context, the EMECAM project (acronym for 'Spanish Multicentric Study on the Relationship between Air Pollution and Mortality'), a collaborative effort, funded by the Spanish Ministry of Health, has evaluated the short-term relationship between the levels of air pollution and mortality (for all and for respiratory and cardiovascular causes) in Spanish urban population, analysing series from the first part of the 90ies (EMECAM, 1999; Schwartz et al., 2001; Ballester et al., 2002; Saez et al., 2002). In the first phase it undertook the assessment of the relationship between seven air pollutants and total daily mortality in 13 Spanish cities (EMECAM, 1999).

Since the year 2000, the project also includes the study of the relationship between air pollution and number of hospital admissions for cardiovascular and respiratory diseases, therefore modifying its name into EMECAS (S means *'Salud'*, Health instead of Mortality). In this phase of the project a total of 16 cities, accounting for more than 10 million inhabitants, are participating. More complete and updated data, both for outcomes and covariates, have been collected, which enable to adequately control of confounding and address an exploration of potential causes of heterogeneity.

This contribution presents results of the first part of the EMECAM project and additional latest results of the analyses of the association of air pollution with cardiovascular morbidity within the EMECAS project.

Results for mortality in EMECAM

Following a standardized methodology, magnitude of association in each city was estimated by Poisson regression in a generalized additive model (GAM). Local estimates were obtained from both single and two-pollutant analyses. Lastly, combined estimates for each cause and pollutant were obtained.

Combined results showed a significant association between air pollution indicators and mortality (Table 1). An increase of 10 $\mu g/m^3$ in the levels of the average of the concurrent and one day lag for black smoke was associated with a 0.8 % increase in mortality (Ballester et al., 2002). The estimates for total suspended particles (TSP) and particles less than 10 µm (PM_{10}) and total mortality were slightly lower. The same increase in concentrations of sulphur dioxide (SO_2) was associated with a 0.5 % increase in

Table 1: Combined estimates for the association between air pollution and mortality; expressed as the increase (in %) in number of daily deaths (and 95% confidence interval) associated with an increase of 10 μg/m^3 (1 mg/m^3 for CO) in the pollutants levels.

		Mortality		
Pollutants*	**Number of cities**	**Total mortality except external**	**Cardiovascular diseases**	**Respiratory diseases**
PM_{10}	3	0.6 (-0.2 to 1.5)	1.2 (0.5 to 1.8)	1.3 (0.1 to 2.6)
Black Smoke	7	0.8 (0.4 to 1.1)	0.3 (-0.2 to 0.8)	1.1 (0.4 to 1.9)
TSP	5	0.4 (-0.3 to 1.2)	0.7 (0.1 to 1.4)	1.2 (0.0 to 2.4)
SO_2	13	0.5 (0.1 to 1.0)	0.6 (-0.1 to 1.2)	1.2 (0.3 to 2.0)
NO_2	8	0.6 (0.3 to 0.8)	0.8 (0.3 to 1.6)	1.2 (0.3 to 2.1)
CO	5	1.5 (0.5 to 2.6)	2.3 (1.3 to 3.2)	3.2 (1.4 to 5.1)

* Pollutants expressed as the average of the 24-hour concentrations in the concurrent and the one lag day.
Models of one pollutant (results for two pollutant models available by request)
(Source: Ballester et al., 2003).

daily deaths, and an increase of 0.6 % in the case of nitrogen dioxide (NO_2). An increase of 1 mg/m^3 in levels of carbon monoxide (CO) resulted in an increase of 1.5 % in total mortality. For groups of specific causes we found higher magnitude in the estimates, especially for respiratory conditions. Ozone only showed statistical significance with cardiovascular mortality (Sáez et al., 2002), but this pollutant was available for three cities. When two pollutant analyses were performed, estimates for all pollutants did not substantially modify, except for SO_2, where estimates for daily levels were strongly attenuated. On the contrary, the association for one-hour maximum levels of this pollutant did not show any change.

New phase: the EMECAS project

Cities participating in the EMECAS project are: Barcelona, Bilbao, Cartagena, Castellón, Granada, Gijón, Huelva, Las Palmas, Madrid, Oviedo, Pamplona, Sevilla, Tenerife, Valencia, Vigo, and Zaragoza (Figure 1). Bilbao, Castellón and Pamplona included their metropolitan area. These cities represent different sociodemographic, climatic and environmental situations at national level.

The participating centres in the EMECAS project are:

- Epidemiology and Statistics Unit of the Valencian School of Studies for Health (Coordinating Centre and Centre for analyses), Valencia
- Research Group on Statistics, Applied Economics and Health, (GRECS), Department of Economics, University of Girona (Centre for analyses), Girona
- Andalusian School of Public Health, Granada (Centre for analyses), Granada
- Public Health Authority, Regional Government, Madrid
- Health Department. Basque Govermment, Bilbao
- Epidemiological Service, Regional Health Authority, Castellón
- Preventive Medicine, University of Santiago, Santiago de Compostela
- Health, Welfare and Labour Department, Zaragoza
- Epidemiology Department, Regional Health Council, Murcia
- Public Health Regional Authority, Social Services Council, Oviedo
- Health Department. Ayuntamiento de Pamplona
- Environmental Health Unit, Public Health Department, Canarian Islands, Las Palmas de Gran Canaria.

Map 1: Cities participating in the EMECAS project

Air pollution data in EMECAS

The EMECAS project, as most epidemiological studies on the effects of air pollution on health, uses data from secondary sources as indicator of population exposure. Data from municipal or regional pollution surveillance networks are used, which measure the quality of the main air pollutants in urban and industrial areas. The characteristics of the monitoring stations, and the analytical methods used respond to national and European standards, and are integrated in a series of common programmes accounting for quality assurance and control. Their location responds to criteria such as priority for surveillance of the pollution emitted by specific industrial plants or by traffic.

We collected data for air pollutants from Air Pollution Networks in each city and calculated daily variables (24-hour mean values) for black smoke (BS), TSP, PM_{10}, sulphur dioxide (SO_2), and nitrogen dioxide (NO_2); 8-hours maximum moving average for carbon monoxide (CO) and ozone (O_3), and lastly, 1-hour maximum of SO_2, NO_2, CO and O_3. Two cities, Pamplona and Vigo only provided data from manual stations. These kinds of monitoring stations yield information on daily (24-hours) concentrations of black smoke (determined by reflectometry) and sulphur dioxide (determined by spectrophotometry). Data from the automatic stations included TSP and PM_{10} values, both determined by beta-ray atomic absorption, SO_2 determined by ultraviolet fluorescence, NO_2 by chemiluminescence, CO by infrared absorption, and O_3 by ultraviolet absorption. The period of the study is not completely coincident in every city but always included the interval from 1995 to 1999, except for Gijón and Oviedo starting in 1993. The minimum length of the series in each city was three years.

Within the EMECAS study, our interest was focused on evaluating the exposure to which the population of the participating cities is exposed to. Therefore, a series of criteria were set to obtain the pollutant indicators providing the most reliable exposure measurement in outdoor settings and, above all, which reflected the daily variations. So, a standardising data collection procedure was followed: a) geographic location of the monitoring stations: only urban monitoring sites were considered; b) completeness criteria for each pollutant: only those stations with data for more than 75 percent of the whole study period were considered, with a minimum of three monitoring stations for each pollutant and city; c) applied methods for filling in missing values: missing values in one station were estimated by a regression model based on the values of the remaining stations, allowing also for seasonal variability. Despite the fact that every city had, at least, valid measurements for particulate matter, the different indicators used, i.e. BS, TSP or PM_{10}, did not allow for a common general indicator. In order to keep down potential differences in their impact on health, and because we failed to obtain a local conversion factor for every city, we decided to maintain the original indicators separately.

Table 2 (Ballester et al., submitted) summarizes the distributions of the pollutant measures for each city. In order to reduce the numbers in the table, we chose the most averaged time variable, i.e. the 24- or 8-hours, for each pollutant.

Table 2: Descriptive data on the air pollutant variables (in µg/m^3, CO in mg/m^3). Average of 24-hours concentrations (for particulates, BS, SO_2 and NO_2), 8-hours maximal moving average (for CO and O_3), and 10th and 90th percentiles.

	Particulates				BS			SO_2		
City	**Type+**	**Mean**	**P10**	**P90**	**Mean**	**P10**	**P90**	**Mean**	**P10**	**P90**
Barcelona	TSP	51.8	29.4	78.8	35.0	19.4	53.0	15.5	6.6	27.9
Bilbao	TSP	58.3	30.3	92.3	18.5	8.8	31.0	18.6	10.2	29.3
Cartagena	TSP	54.9	32.5	79.9				27.1	14.6	40.8
Castellon	TSP	60.4	32.0	92.1				7.7	3.8	12.7
Gijon	TSP	77.4	47.4	118.3				29.4	10.3	52.4
Granada	PM10	43.2	24.8	62.6				19.1	8.8	31.5
Huelva	PM10	38.6	23.1	57.3				11.9	4.5	22.6
Las Palmas	TSP	63.4	30.3	94.7				13.7	7.0	21.9
Madrid	PM10	35.7	21.4	54.4				21.8	8.7	41.8
Oviedo	TSP	76.0	48.3	111.8				40.9	16.3	75.5
Pamplona					7.4	2.3	13.0	7.6	1.8	17.0
Sevilla	PM10	41.9	27.3	57.6				9.6	5.6	14.6
Tenerife	TSP	46.1	19.8	76.6				13.5	7.7	20.6
Valencia	TSP	61.0	44.1	80.7	40.3	20.3	66.4	16.6	9.4	24.4
Vigo					79.4	43.9	122.3	9.3	2.6	18.2
Zaragoza	PM10	32.8	17.3	50.3	40.4	23.8	61.3	9.3	2.0	19.9

	NO_2			CO			O_3 *		
City	**Mean**	**P10**	**P90**	**Mean**	**P10**	**P90**	**Mean**	**P10**	**P90**
Barcelona	51.5	29.5	74.4	1.7	0.4	3.4	68.8	41.5	99.1
Bilbao	51.6	36.9	66.7	1.4	0.9	2.0	54.1	28.3	81.6
Cartagena							54.2	36.7	73.8
Castellon	23.4	11.4	39.2				88.5	66.6	110.3
Gijon	43.7	29.1	59.9	2.3	1.1	3.9	48.4	21.3	76.3
Granada	65.9	46.3	86.1	2.8	1.7	4.1	74.4	46.8	103.3
Huelva	30.7	17.6	46.1				80.2	47.2	118.9
Las Palmas	43.1	7.3	78.6	2.2	0.4	4.2	17.2	9.3	27.3
Madrid	68.5	48.5	93.5	2.0	0.9	3.4	63.2	32.0	96.3
Oviedo	50.5	33.3	68.6	1.9	0.9	3.3			
Pamplona									
Sevilla	43.7	28.1	60.0	1.7	0.9	2.8	60.9	35.4	88.2
Tenerife	26.2	13.8	40.7	1.1	0.3	2.1	33.6	13.0	57.2
Valencia	76.2	55.9	99.6	2.6	1.6	3.8	46.0	30.8	59.1
Vigo									
Zaragoza	47.8	25.6	75.0				45.9	26.2	73.7

+ Type of particulates indicator measured: TSP or PM_{10}
* summer season: May to October

For ozone the estimates for the summer period are shown. The series of pollutants, as those of hospital admissions, presented low percentages of missing values. For pollutants, only 4 out of 63 (6 %) of the series analysed presented missing values over 5 %. Correlations between concurrent measurements at different stations in the same city were very heterogeneous ranging between 0.01 to 0.93, being, in most of them, moderate to high (Pearson correlation: 0.3 to 0.7). However, in few cities, correlation was poorer for some pollutant indicators, especially for SO_2. Particulates, SO_2, CO and

NO_2 were, in most cases, positively correlated. CO co-varied consistently with black smoke (0.69 to 0.72) and quite well with PM_{10} (0.39 to 0.65), with SO_2 (0.09 to 0.79) and with NO_2 (0.25 to 0.73). Ozone presented a significant negative correlation with the other pollutants, in general, and a positive one with temperature (Pearson correlation: 0.29 to 0.74). In very few cases, however, a positive correlation between O_3 and other pollutants was found.

Although the purpose of the EMECAS study was not the comparison of levels of pollutants between cities, and without disregarding the considerations expressed above (use of secondary data, seeking of time representativeness), it is interesting to examine such results from a global perspective providing a general overview of the situation of air pollutants within the group of Spanish cities.

First of all, we can observe that not all cities had available data on each pollutant. This was particularly noticeable for particulates, as three different indicators are used in the air pollution networks. For instance, PM_{10} was measured in 5 cities only.

Comparing these PM_{10} levels with the limit values in the European Union, we observed that all the mean values for PM_{10} are around the annual limit values of 40 µg/m³ established for the European Union to be reached in 2005. For TSP, mean values ranged from 50 close to 80 µg/m^3. For black smoke, levels varied greatly from quite low levels in Pamplona to the highest ones in Vigo, close to 80 µg/m^3.

We obtained more complete data for gaseous compounds, for instance, SO_2 was measured in all cities. Although there is diversity on SO_2 levels, all the mean values for SO_2 are quite far below the limit values established for the European Union. However, NO_2 levels do not exceed the annual limit values in most cities. We obtained data from 13 cities, and all except 3 (Castellón, Huelva and Tenerife) have mean levels above the correspondent limit value in the European Union (40 µg/m^3). For CO, the mean levels are quite below the established ones, ranging from 2 to 4 mg/m^3 the 90th percentile of the 8-hour maximum moving average. Finally, in some cities for O_3 during the summer season the 90th percentile ranged from 60 (Valencia) to 120 µg/m^3 (Huelva).

Association between air pollution and cardiovascular admissions within the EMECAS project

Magnitude of association in each city was estimated using GAM in Poisson regression and controlling for confounding and over-dispersion. For each cause, lagged effects, up to three days, of each pollutant were examined. Data were analysed using S-Plus GAM function with stringent convergence criteria. Combined estimates were obtained under a ‘fixed effects’ model, and, if heterogeneity, under 'random effects’ ones. For ozone the analyses were restricted to the summer period (May to October).

Local estimates were, mostly, positive and more consistent in lags 0 (concurrent day) and 1, except for ozone with a more delayed relationship. Following that, we selected the average of the concurrent and one day lag for all the pollutants, except for ozone (average of the 2 and 3 day lags) to show the estimates of the relationship. As a summary, combined estimates showed an association with cardiovascular admissions (Ballester et al., submitted). An increase of 10 µg/m^3 in the PM_{10} level was associated with a 0.9 % (95 % CI: 0.4-1.5 %) increase in the number of hospital admissions for cardiovascular diseases (CVD), and 1.6 % (95 % CI: 0.8-2.3 %) for heart diseases (HD).

The same increase in concentrations of NO_2 was significantly associated with a 0.4 % increase in CVD, and 0.9 % in HD admissions. For ozone the corresponding estimates were 0.7 in both cases. An increase of 1 mg/m^3 in the CO level was associated with an increase of 2.1 % in CVD, and 4.2 %

in HD admissions. The estimates for TSP, black smoke and SO_2 were lower and in some cases non-significant.

Discussion and conclusions

This is the first multicentre study assessing the impact of air pollution on health in Spain.
The EMECAM-EMECAS project represents a collective effort of a considerable number of research centres and public health services which collected, analysed, interpreted and broadcasted the results on the impact of air pollution in Spain.
Its results provide, for the first time, a joint estimate of the short-term effect of air pollution on mortality of Spanish urban population.

Association with mortality

- The results presented have shown an association between mortality and air pollution in urban population in Spain.
- This association is greater for groups of specific causes, especially respiratory ones.
- Owing to the co-linearity between pollutants, it is difficult to assign an independent role to an isolated pollutant.
- CO estimates showed greater stability and SO_2 1-hour maximum presented a clearer impact on mortality than SO_2 24-hour, particularly for respiratory causes.
- Our findings are comparable to the results obtained in other projects, which used the same methodological approaches.

Association with cardiovascular admissions

- There is a short-term association between all air pollutants and hospital admissions for cardiovascular diseases.
- Higher estimates for cardiac diseases are found.
- There is no association with cerebrovascular admissions except some suggestion for ozone.
- It is difficult to assign the effect to an isolated pollutant, but, quite robust estimates in two pollutant models, for CO, PM_{10} and O_3.
- These results are consistent with other epidemiological studies and coherent with previous studies in Spain.
- Further analysis and interpretation is needed on causes for heterogeneity (effect modification).
- Association with CO is detected at levels quite below the established limit values.

Policy implications

- Air pollution at current levels is still a health risk among the urban population in Spain.
- Public actions reducing the ambient levels of air pollutants would have beneficial results on the health of the population.
- The information provided by the EMECAS project may be used for the design and development of air quality improvement and control plans.
- On the other hand, knowledge of these relationships may contribute to the implementation of diagnostic and preventive strategies within the clinical practice.

The methodological experience acquired, as well as the setting of a multicentre network, represent an added value interesting for the development of future health and environment information systems in Spain.

Acknowledgements

This study was funded from the Spanish Ministry of Health (FIS 00/0010). Our kind thanks to all the professionals and institutions that have made this study possible by providing the essential data, in particular to the Information Services of the National and Regional Health Systems, Air Pollution Networks and National Institute of Meteorology. The authors gratefully thank Susanna Pérez for her help in the manuscript edition.

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NOTES AND NEWS

Air Quality Monitoring to improve European air quality - WHO Collaborating Centre for Air Quality Management at UBA considers new EU members "well prepared"

Clean air is as crucial for human health as pure drinking water and good food. "Air pollutants don't stop at national borders. We need close international cooperation to combat air pollution. We also need reliable measurements and calibration techniques," says Prof Dr Andreas Troge, president of the Federal Environmental Agency (UBA). Currently an international expert meeting takes place at the UBA pilot station in Langen (near Frankfurt on Main), organised by the WHO Collaborating Centre for Air Quality Management and Air Pollution Control. Reliable measurement results are important to improve the utilization of data in health risk management and to promote the exchange of information. They are the base for legislation on air quality matters. Facing the enlargement of the EU, UBA considers the new member states to be well-prepared. Evidence is given by the results of the international quality assurance and control programme to harmonise air quality measurements, analysis and calibration techniques for currently 52 member states of the WHO European Region. The programme is supported by the German Environment Ministry. Between July 1994 and April 2004, twelve so-called intercomparisons on air quality monitoring were conducted for inorganic pollutants (oxides of nitrogen, sulphur dioxide, carbon monoxide, and ozone). Within this decade, 37 air laboratories of national public health and environmental institutions of 25 countries (from Belgium to Uzbekistan) participated. For various air measurements and air calibration techniques, the intercomparisons produced satisfactory results. In particular, manual methods are mainly in a good, and, for several concentration levels and measurement periods, partly excellent accordance with the data obtained by automatic devices. Furthermore, the intercomparisons showed results improving with respect to comparability and compatibility within this programme. There is an urgent necessity of continuing the programme in the future to check and stabilize the level reached. In cooperation with WHO, UBA strives to transfer standards and technologies in air quality applied in Germany and stress the importance of intensifying the integration process of those countries not yet belonging to EU.

UBA Press Release No. 37 from 29 April 2004 (http://www.umweltbundesamt.de/uba-info-presse-e/2004/pe04-037.htm).

Further reading: The results of all Intercomparisons are published in detail in the series "Air Hygiene Report" No. 7, 9, 11, 13, 15, to be obtained free of charge (www.umweltbundesamt.de/whocc/titel/titel21.htm).

Launch of the European Pollutant Emission Register EPER - Public can access online register of industrial pollution

The European Commission and the European Environment Agency have launched the European Pollutant Emission Register, the first register of industrial emissions into air and water in all the European Union countries. It has been seven years in the planning. The Register makes available to the public information on pollution from around 10,000 large industrial facilities in the EU and Norway, allowing the user to group information and compare, by pollutant, sector, air and water, or country. It is hoped that groups "will engage local industries in a dialogue about how emissions can be further reduced". It will be available in all EU languages in the coming months.

See: http://www.eper.cec.eu.int/

Assessment of essential paths of contamination of the German population by means of multivariate analysis

Based on the data of the German Environmental Survey 1998, the body burden with arsenic, lead, cadmium, and mercury, as well as the precious metals gold and platinum (As, Pb, Cd, Hg, Pt, Au) in the general population was examined. Relevant factors were selected from potential predictors by means of stepwise multiple linear regression (in this abstract only volume-related models are presented). The share of variance in the arsenic load in urine explained by the model is 29.5 %. Short-term fish consumption and frequency of fish consumption (joint variance component (VC): 11.8 %) and creatinine concentration (17.4 %) were the main predictors. An increase in As-load is associated with an increase in As-content in tap water and an increase in alcohol consumption. 25.1 % of the variance in lead concentration in blood could be explained. Among other factors a higher lead burden is observed with increasing age, in men, with increasing consumption of beer, wine and cigarettes, with increasing haematocrit level, and with increasing Pb-consumption via drinking water. For cadmium the variance explained (VE) is 56.2 % (blood) and 46.0 % (urine). Smoking behaviour (VC: 54.6 % / blood, 14.9 % / urine) is quantified through logarithm of the current number of cigarettes smoked, and long-term smoking exposure (packyears). For Cd in blood, haematocrit and ferritin are relevant predictors. Hg-load in blood (VE: 19.3 %) is mostly explained by short-term (VC: 2.9 %) and long-term (VE: 7.9 %) fish consumption, additionally by the number of teeth with amalgam filling. Hg-load in urine / VE: 50.5 %) is mostly explained by the number of teeth with dental fillings containing amalgam (VC: 19.9 %), chewing gum consumption among persons with amalgam fillings (VC: 6.3 %) and creatinine concentration (16.9 %), but hardly by fish consumption (0.2 %). The variance of gold/platinum in urine was explained to an extent of 34.9 % / 23.5 %. Creatinine concentration accounts for 20.6 % / 2.1 %, number of teeth with dental filings containing precious metals accounts for 8.6 % / 12.5 % of the variance. Chewing gum consumption of persons with dental fillings based on either of the precious metals is relevant (Au 1.5 % / Pt 1.4 %). An effect of traffic on Pt-content in morning urine could not be detected.

Abstract taken from: WaBoLu-Hefte 03/04, Umwelt-Survey 1998, Band VII: Arsen, Schwer- und Edelmetalle in Blut und Urin der Bevölkerung in Deutschland – Belastungsquellen und –pfade, ISSN 0175-4211, available in German only (10,- €) via W+V-Verlag, Wolframstr. 95-96, 12105 Berlin, Germany.

Review of methods for monitoring of PM_{10} and $PM_{2.5}$ WHO/JRC Workshop, 11-12 October 2004, Berlin, Germany

The workshop will review methods for $PM_{2.5}$ and PM_{10} monitoring, their comparability and quality. Based on the experiences of the field intercomparisons, which were performed as part of the CEN procedure to establish a reference method, the features of the proposed reference methods will be presented. The workshop will also review and discuss the experiences of the WHO/EURO Member States in development and operation of the PM monitoring networks oriented towards the population exposure assessment. The technical specification of the equipment, network design and operational procedures (including QA/QC) will be presented and discussed. National coordinators of air quality monitoring networks and public health professionals involved in assessment of health impacts of air pollution from all parts of Europe, including countries of the EU, Eastern Europe, Caucasus and Central Asia, are expected to attend the workshop.

See: www.euro.who.int/air

MEETINGS AND CONFERENCES

Healthy Buildings 2003 – New insights in the microbiology of damp buildings

The Healthy Buildings Conference 2003 was held 7-11 December at the National University of Singapore. The main topics were pollutants in indoor air (chemical, microbial, particulate matter), health effects and sick building syndrome (SBS) symptoms, thermal comfort, ventilation, and energy efficiency.

From a microbiological point of view the conference offered exciting new insights into the microbial diversity of damp buildings. Since many years, the focus of microbiological examinations in damp buildings has been on fungi and their possible health effects on the occupants. Investigations have been made concerning the fungal diversity and their metabolic by-products like mycotoxins and MVOC (microbial volatile organic compounds). The diversity of bacteria in water-damaged buildings has received much less attention. Research concerning bacteria in indoor environments has so far concentrated on endotoxins and MVOC production.

Several new aspects on **fungi** in indoor environments were presented at the conference. These included

- fungi in different elements of building constructions,
- transport of spores and mycotoxins through building structures, and
- the production of MVOC from new building material.

Fungi on materials in different elements of building

Materials in water-damaged buildings are often analysed for fungi to detect the extent of the damage. In a study of Reiman et al. (1) from Finland it has been shown that not only the type of material but also the location of damp material in the building construction has an effect on the fungal species present. Some examples: *Stachybotrys* was found on paper board facing room space and in the inner side of wall constructions but never on the outside of wall constructions. *Trichoderma* was most often found in wood samples in inner side of wall constructions. *Cladosporium*, in contrast, was found in materials of the outer side of wall constructions and its concentration decreased towards the room space indicating its outdoor source. In summary, *Acremonium*, *Aspergillus versicolor*, *Stachybotrys*, *Trichoderma* and *Streptomyces* (actinomycetes!) are indicator microorganisms of moisture damage if found in materials located in the inner side of constructions. Such information is important to consider in health risk assessments.

Transport of spores through building structures

Building structures like walls or floors with insulation material are often considered a barrier for the spread of spores in the building. The study of Airaksinen et al. (2) demonstrated that small fungal spores - like those produced by the genera *Penicillium* and *Cladosporium* – are able to penetrate building structures provided there is a pressure difference over the building. Penetration was enhanced if the construction included open pipes. No penetration of the floor construction with mineral wool was detected for larger particles > 4 µm. These results clearly show that spores from fungal growth hidden within building constructions may penetrate into the indoor environment and thus present a health risk if there is sub-atmospheric pressure in the building e.g. due to mechanical exhaust ventilation. These findings support the requirement of removal of fungal growth within building constructions for appropriate remediation.

Penetration of mycotoxins through building structures

Not only spores but also mycotoxins have been reported to penetrate through floor constructions. Lorenz et al. have detected (3) aflatoxin-like substances in floor dust of an office building several month after a water damage in the floor had been remediated by drying only. No visible mould growth was present in the building. A new *Aspergillus* species (*A. pseudoustus*) producing these toxins was, however, detected on the waxy paper in the floor construction. The employees in the office building showed different unspecific symptoms like headache, skin problems, respiratory problems and sore throat. Complaints were not associated with the immediate water damage but started after the construction had been dried. It is assumed that not fungal spores but toxins - produced in the floor construction - are the causative agents of these health problems. Accumulation of toxins in the floor dust shows the possibility of fungal toxins to penetrate floor constructions and possibly cause health effects in indoor environments.

MVOC (microbial volatile organic compounds) from new material

The usefulness of MVOC measurements in indoor environments to detect hidden mould growth was controversially discussed at the meeting. The reliability of this method is hampered by the fact that most of the substances considered to be MVOC may also be produced by other processes in indoor environments (e.g. cooking, baking, smoking). Therefore, a walk through with a detailed questionnaire was considered necessary to be able to correct for possible confounders when measuring MVOC. Virnich et al. (4) described an interesting source of MVOC in indoor environments. New building materials like mineral wool, Styrofoam, and gypsum board were found to emit typical MVOC, like 1-octen-3-ol and dimethylsulphide. The authors conclude from their investigations that this MVOC emissions can be ascribed to microbial colonization by fungi or bacteria during production or storage of the material. Therefore, it is recommended not to perform MVOC measurements in newly built houses during the first 1-2 years.

At the conference it became very clear from several studies that microbiology in damp buildings does not only include fungi but is far more diverse and complex than previously thought. **Bacteria and protozoa** have been shown to happily live in damp spots.

Actinomycetes in damp building materials

Epidemiological studies in indoor environments have shown a clear correlation between dampness in buildings and adverse health effects of the occupants. No dose-response relationship has, however, been found between the concentration of fungi and the health effects. One possible explanation is that the occupants in damp buildings are not only exposed to fungi but also to bacteria, especially actinomycetes, which are known to cause adverse health effects. Lorenz et al. (5) reported that bacteria were frequently found in water-damaged buildings. About 80 % of samples from damp material (n=561) contained bacteria, and actinomycetes were found in about 60 % of the samples. The actinomycetes identified belonged to the genera *Nocardiopsis*, *Promicromonospora*, *Pseudonocardia*, and *Streptomyces*. Several new species were found. These findings are of great importance for health risk assessment since actinomycetes are known to produce toxic metabolites and some species are pathogenic. Recent findings indicate a correlation between growth of actinomycetes in indoor environments and rheumatoid symptoms of the occupants.

Amoebae in damp building materials

While growth of fungi in damp building materials has been extensively studied, hardly any investigations have been made concerning “higher” organisms. Yli-Pirilä et al. (6) studied the occurrence of amoebae and other protozoa in moisture-damaged buildings. Amoeba were found in 22 % of samples (n=124) from damp materials. Their occurrence was correlated with the presence of actinomycetes and fungal species which are indicative of moisture damage (e.g. *Chaetomium*, *Trichoderma*). Further protozoa (ciliates and flagellates) were detected in almost every sample (n=11) from severely damaged materials. In a single sample even nematodes were found. Apart from the pathogenicity of several species of protozoa, protozoa can act as host cells for pathogenic bacteria, such as *Legionella* and *Chlamydia*. The implication of these findings for health risk assessment is yet to be established.

This presentation received the reward for the best study in the field of microbiology at the Healthy Buildings 2003.

At the last plenary session of the conference, J.D. Sprengler presented the future research topics in indoor air quality "Moving into the 21st Century". Microbiology was stressed as important topics besides POPs, phtalates and endocrine-disrupting substances. From the studies presented above, more research is especially needed in the field of actinomycetes and protozoa in indoor environments and their possible health effects.

The conference proceedings are compiled published in the book:
Healthy Buildings 2003, Vol. 1-3, Eds. Tham, Sekhar and Cheong (ISBN 981-04-9974-4).

<u>Conference proceedings</u>

(1) M. Reiman, L. Kujanpää, R. Kujanpää (2003): Materials´ microbiology in different elements of buildings, Vol. 1, pp 572 – 577.

(2) M. Airaksinen, P. Pasanen, J. Kurnitski, O. Seppänen (2003): Transport of fungal spores and particles through a building structure, Vol. 2, pp 182 - 187.

(3) W. Lorenz, R.M. Kroppenstedt, C. Trautmann, E. Stackebrandt, I. Dill (2003): Actinomycetes in building materials, Vol. 1, pp 583 - 589.

(4) L. Virnich, W. Lorenz, C. Trautmann (2003): MVOC out of new materials, Vol. 1, pp 566 - 571.

(5) W. Lorenz, C. Trautmann, I. Dill, M. Gareis (2003): Detection of an aflatoxin-like substance in an office building, Vol. 1, pp 560 - 565.

(6) T. Yli-Pirilä, J. Kusnetsov, S. Haatainen, P. Javala, M. Hänninen, M.-R. Hirvonen, M. Reiman, M. Seuri, A. Nevalainen (2003): Amoebae and other protozoa in moisture-damaged building materials, Vol. 1, pp 578 - 581.

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National Air Pollution Network (NABEL): 25 years of data for environmental protection and research 16 January 2004 in Dübendorf, Switzerland

On occasion of the 25th anniversary of the Swiss national air pollution monitoring network (NABEL), a symposium was held at the Swiss Federal Laboratories for Materials Testing and Research (EMPA). The NABEL network is jointly operated by EMPA and the Swiss Agency for the Environment, Forests and Landscape (SAEFL). Hence, the symposium focussed on both environmental protection policy and research. The meeting was attended by about 120 participants and was aimed at presenting the development of the national monitoring network and the use of its data in various applications. These range from the implementation of air pollution policy to research in atmospheric chemistry and the assessment of the effects of air pollution. The monitoring network was founded in the late 1970s, a time of great public concern about environmental problems. Since then, it has been enlarged and continuously adapted to new needs.

A series of papers demonstrated how the NABEL network is operated, the use of its data in national policy, and contributions made to international programmes aimed at improving air quality. Looking back over recent decades, air pollution control has been a success story in Switzerland as the ambient concentrations of many pollutants such as sulphur dioxide, carbon monoxide, heavy metals, in particular lead and cadmium are nowadays below the ambient air quality standards. This was achieved by strict emission regulations and their enforcement. However, there remain important problems to be solved such as the reduction of high ozone levels, the control of particulate matter emissions and the reduction of nitrogen deposition.

Ozone in the lower troposphere exceeds the air quality standards regularly as soon as certain meteorological conditions occur, despite the strong reduction of emissions of precursor substances. The data from high alpine stations such as the NABEL station at the Jungfraujoch prove useful to investigate the trends in chemical composition of the free troposphere and to reveal the increase in background ozone. Presumably, the increase in hemispheric emissions of ozone precursors has compensated for the benefits of local emission reductions. Long-range transport of air pollutants was also demonstrated in a paper describing a new method of identifying Saharan dust in particulate matter. At the Jungfraujoch about 25 % of the annual mean concentration (3.5 microgram per cubicmeter) of total suspended matter is attributed to Saharan dust. The long time series of air quality data of the NABEL network are regularly used for medical studies investigating the link between air pollution and effects on health. Higher levels of air pollution, characterized by nitrogen dioxide and PM_{10}, lead to more frequent respiratory symptoms and diseases, whereas no influence of air pollution on allergies was observed. At some stations of the NABEL network, the corrosion of different materials is investigated, a topic of great economic concern. Copper, for instance is corroded by ozone as well as by sulphur dioxide.

In the next few years, the NABEL network will focus on a more detailed physical and chemical characterization of particulate matter, and will also soon start doing measurements of ammonia.

The conference proceedings can be obtained from the organizers (contact: luftreinhaltung@buwal.admin.ch) or be downloaded as pdf file (http://www.umwelt-schweiz.ch/buwal/de/fachgebiete/fg_luft/luftbelastung/publikat/nabel/),
(note: the papers are in German or French).

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PUBLICATIONS

WHO

Health and Global Environmental Change Series, No. 2: Heat-waves: risks and responses

WHO Regional Office for Europe, Copenhagen 2004, 124 pages, ISBN 92 890 10940, available through the net: www.who.dk/document/E82629.pdf .

Heat-waves: risks and responses is a joint report by the German Weather Service (DWD), the London School of Hygiene and Tropical Medicine and WHO/Europe.
A changing climate is expected to increase average summer temperatures and the frequency and intensity of hot days. Heat-waves in Europe are associated with significant morbidity and mortality. A preliminary analysis of the 2003 heat-wave in Europe estimated that it caused 14 802 excess deaths in France, 2045 excess deaths in the United Kingdom, 2099 in Portugal. Ongoing epidemiological studies will better describe and contribute substantial evidence to the understanding of health effects of heat-waves in Europe and add significantly to targeting interventions.

This report summarizes the main findings of reviews carried out within the climate Change and Adoption Strategies for Human health in Europe (cCASHh) project and of a consultative workshop with experts and stakeholders from 10 countries. It addresses the health impact of heat as well as aspects of prevention and adaptation such as heat health warning systems, urban planning elements and aspects of building design.

Climate Change and Human Health – Risks and Responses

A. J. McMichael et al., WHO Publications, Geneva 2003, 250 pages, ISBN 92 4 156248 X, Sw. Fr. 20,-, in developing countries Sw. fr. 14,-.

Global changes have heightened awareness that the long-term good health of populations depends on the continued stability and functioning of the biosphere's ecological, physical and socio-economic systems.
The world's climate system is an integral part of the complex of life-supporting processes. Climate and weather have always had a powerful impact on human health and well-being. But like other large natural systems, the global climate system is coming under pressure from human activities. Global climate change is, therefore, a newer challenge to ongoing efforts to protect human health. This volume seeks to describe the context and process of global climate change, its actual or likely impacts on health, and how human societies and their governments should respond, with particular focus on the health section.

Making a Difference: Indicators to Improve Children's Environmental Health

D. Briggs, WHO Publications, Geneva 2003, 46 pages with accompanying CD-ROM, ISBN 92 4 159059 9, Sw. fr. 15,-, in developing countries Sw. fr. 10,50.

"Making a Difference…" describes a child-specific conceptual model for indicators, the so-called MEME (Multiple Exposures Multiple Effects) model, and discusses the criteria for designing, collecting and reporting children's environmental health indicators. The enclosed CD-ROM contains a set of template indicators for the links between environmental exposures and the five biggest killers of children under five: perinatal diseases, respiratory diseases, diarrhoeal diseases, vector-borne diseases and physical injuries.

WHO-reports, available through the net

You can find the **St. Petersburg workshop report** on Air quality and health in Eastern Europe, Caucasus and Central Asia at:
http://www.euro.who.int/eprise/main/WHO/Progs/AIQ/NewsEvents/20030922_2 .
Two reports of the WHO project report '**Systematic Review of Health Aspects of Air Pollution**' (a brief outline of this project is available on the following web page:
http://www.euro.who.int/eprise/main/WHO/Progs/AIQ/Activities/20020530_1.) are now available on the WHO web site: The first of the two reports contains a detailed description of results of a meta-analysis of time series and panel studies of particulate matter (PM) and ozone (O_3). This work was guided by a WHO Task Group. The concentration-response functions described in the report are suitable for calculation of health impacts of air pollution in Europe. The report itself is available at the following address:
http://www.euro.who.int/document/E82792.pdf .
The second report contains detailed answers to a second set of questions received from CAFE in late spring 2003. The questions included a request for information on the relevance of hot-spot exposures for health effects, on uncertainties, on susceptible population groups, etc. The answers were agreed upon by a WHO Working Group meeting in January 2004. The report itself is available at the following address:
http://www.euro.who.int/document/E82790.pdf .
The WHO/AIQ web page also contains an updated version of the software tool **AirQ2.2**, allowing estimation of impacts of air pollution on life expectancy in the exposed populations. You can download it from:
http://www.euro.who.int/eprise/main/WHO/Progs/AIQ/Activities/20040428_2 .

OTHERS

Collection Questions en santé publique : Geography and Health

L. Toubiana et al., Institut national de la santé et de la recherche médicale (INSERM), Paris 2003, 247 pages, ISBN 2 85598 823 3, € 28,-, for more information, see : www.inserm.fr .

For centuries, the geographic approach, in particular cartography, has made it possible to unify different types of data on a single platform thereby revealing spatial relationships which could not be identified by other means. The fast development of sciences and technology of information and communication favoured the interaction between epidemiology, public health and geography. The approach of this piece of work is clearly multidisciplinary. It requires expertise from a variety of research fields (geographers, demographers, health economists, sociologists, mathematicians, statisticians, data processing specialists and public health officers). We also have to consider developments in other fields such as telecommunication, marketing, regional planning…
In 1997, the first international congress of Geography and Medicine, Geomed '97, was organized in Rostock. Since that time, the congress Geomed '99 and Geomed '01 under the auspices of INSERM, WHO, University, IRD, AP-HP, NASA, and CNES were successful at the international level. An important number of scientific papers were presented and more than twenty countries participated.

Advances in Ecological Sciences, Vol. 17: Environmental Health in Central Asia – The Present and Future

D. Fayzieva (ed.), Academy of Sciences, Uzbekistan, 284 pages, ISBN 1 85312 945 3, € 126,-.

This book provides information on how environmental conditions in Central Asia have been effected by anthropogenic activity and reviews research carried out during the last decades on the impact of the environment on the health of the region's people. The contributors' aim is to promote a better understanding of current environmental health problems in the area and to prompt joint multidisciplinary research by local scientists and their colleagues from other countries.
Partial contents: Air Quality and Population Health in Central Asia; Hydrosphere and Health of Population in the Aral Sea Basin; Influence of Environmental Factors on Development of Non-Communicable Diseases; Environment and Infectious Diseases; Occupational Hygiene in Industry and Agriculture and Some Aspects of Professional Pathology; Use of Pesticides in Agriculture and Health of Population in Central Asia.

Proceedings of 4th International Conference on Urban Air Quality, Measurement Modelling and Management, Prague, Czech Republic, March 2003

R. S. Sokhi, J. Brechler (eds.), Atmospheric Science Research Group, Science and Technology Research Centre, University of Hertfordshire, College Lane, Hatfield, AL10 9AB, UK, 499 pages, £ 42,- + £ 7,- postage & packing.

A limited number of copies of the Proceedings of 4th International Conference on Urban Air Quality, Measurement Modelling and Management, held in Prague, Czech Republic, 25 to 27 March 2003, are available for purchase. The book contains a wide range of short papers on Urban Air Quality Research covering recent achievements, new developments and future directions.

Indoor Environment – Airborne Particles and Settled Dust

L. Morawska, T. Salthammer (eds.), Wiley-VCH, Weinheim 2003, 450 pages, ISBN 3 527 30525 4, € 149,-.

Covering the fundamentals of airborne particles and settled dust in the indoor environment, this handy reference investigates relevant definitions and terminology, characteristics, sources, sampling techniques and instrumentation, exposure assessment, and monitoring methods.

Advances in Air Pollution, Vol. 12: Regional and Local Aspects of Air Quality Management

D. M. Elsom, J. W. S. Longhurst (eds.), WIT Press, Southhampton (UK) 2004, 340 pages, ISBN 1 85312 952 6, € 139,50.

Reviewing the experience and practice of air quality management at the local and regional scale, this volume is designed for use by researchers and practitioners in the field. It features contributions drawn from Europe, South America, Asia, Australia and North America.

Expositionen und gesundheitliche Beeinträchtigungen in Bürogebäuden – Ergebnisse des ProKlimA-Projektes

W. Bischof et al. (eds.), Fraunhofer IRB Verlag, Stuttgart 2004, 309 pages, ISBN 3 8167 6408 8, € 49,-.
Note : Available in German only !

COMING EVENTS

2004

June 2004

Ninth Conference on Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes
1-4 June, Garmisch-Partenkirchen, Germany.
For more information, see: www.harmo.org/harmo9

The Sustainable City 2004 – Third International Conference on Urban Regeneration and Sustainability
16-18 June, Siena, Italy.
For more information, see:
www.wessex.ac.uk/conferences/2004/index.html

AWMA 2004 – 97th Annual Conference and Exhibition of the Air and Waste Management Association
20-24 June, Indianapolis, Indiana, USA.
For more information, see: www.awma.org

XIIth International Conference on Modelling, Monitoring and Management of Air Pollution
30 June – 2 July, Rhodes, Greece. For information, see:
www.wessex.ac.uk/conferences/2004/air2004/cfp.html

August 2004

XIIIth World Clean Air and Environmental Protection Congress and Exhibition
22-27 August, London, UK.
Associated event:
Global Forum: The Role of Regional Programmes in Abating Long Range Transport of Air Pollution (London, 25-26 August)
For more information, see:
www.kenes.com/cleanair/

Fifth Symposium on the Urban Environment
23-27 August, Vancouver, Canada. The symposium is being held in conjunction with the

- *26th Conference on Agricultural and Forest Meteorology*,
- *13th Joint Conference on the Applications of Air Pollution Meteorology*, and the
- *16th Conference on Biometeorology and Aerobiology*.

For more information, see: www.ametsoc.org

September 2004

Second WHO International Housing & Health Symposium
29 September – 1 October, Vilnius, Lithuania.
For more information, see:
www.vilnius.lt/housimg2004

October 2004

Third Annual AIRNET Conference
21-23 October, Prague, Czech Republic.
For more information, see: http://airnet.iras.uu.nl

December 2004

Monitoring Ambient Air: Implications and Implementations of the New Directives and Standards – Conference and Exhibition
15-16 December, London, UK.
For more information, see: www.aamg-rsc.org .

2005

April 2005

Urban Transport 2005 – XIth International Conference on Urban Transport and the Environment in the 21st century
12-14 April, Algarve, Portugal. For more information, see : www.wessex.ac.uk/conferences/2005/ut05

June 2005

Acid Rain 2005 – 10th International Conference on Acid Deposition
12-17 June, Prague, Czech Republic.
For more information, see: www.chmi.cz/indexe.html

September 2005

Indoor Air 2005 – 10th International Conference on Indoor Air Quality and Climate
4-9 September, Beijing, China.
For more information, see: www.indoorair2005.org.cn/

17th Int. Congress on Biometeorology 2005
5-9 September, Garmisch-Partenkirchen, Germany.
For more information, see: www.icb2005.de

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.

The NEWSLETTER is published twice a year, circulated in 1700 issues, and distributed to readers in more than 50 countries. The NEWSLETTER does not constitute formal publication; it should not be reviewed, abstracted or quoted without prior permission. Authors alone are responsible for their articles.

Cover cartoon by Prof Michael Wagner, Berlin

Published by

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