CHARACTERISTICS AND HIA FINDINGS CITY BY CITY

ATHENS CITY REPORT

Background

Athens has a population of more than 3 million inhabitants, 13% of whom are over 65 years old. Athens lies in a valley totalling 350 km^2 surrounded by three mountains and the sea. The major axis of the valley runs from the north-east to the south-west for about 30 kilometres. Most industry lies close to the sea and the harbour of Piraeus in the south-western part of Athens. The climate of Athens is typically Mediterranean. The mean daily temperature during the winter months is 9.9°C, and the minimal daily temperature falls below 0°C only two or three times per year. During the summer months the mean daily temperature is 25.8°C, and the mean value of the maximum daily temperature slightly exceeds 31°C. Insolation is strong with average daily values on the order of 22 MJm^{-2} in the summer and 8 MJm^{-2} in the winter[15]. The prevailing wind direction is north-north-east at the end of summer, in autumn and in winter, and south-south-west in spring and the beginning of the summer.

The Ministry of Environment, Planning and Public Works has been responsible for monitoring air pollution in the Athens area since 1982. The monitoring network has recently been restructured and modernised, but the measurements from the new system are not available yet. In 1994, 11 stations were operating, of which seven were measuring black smoke. For the calculations here we used two stations, one in central Athens and one in Pireaus. These had the most complete series of measurements and are characterised by the ministry as “commercial-urban” sites.

Sources of air pollution

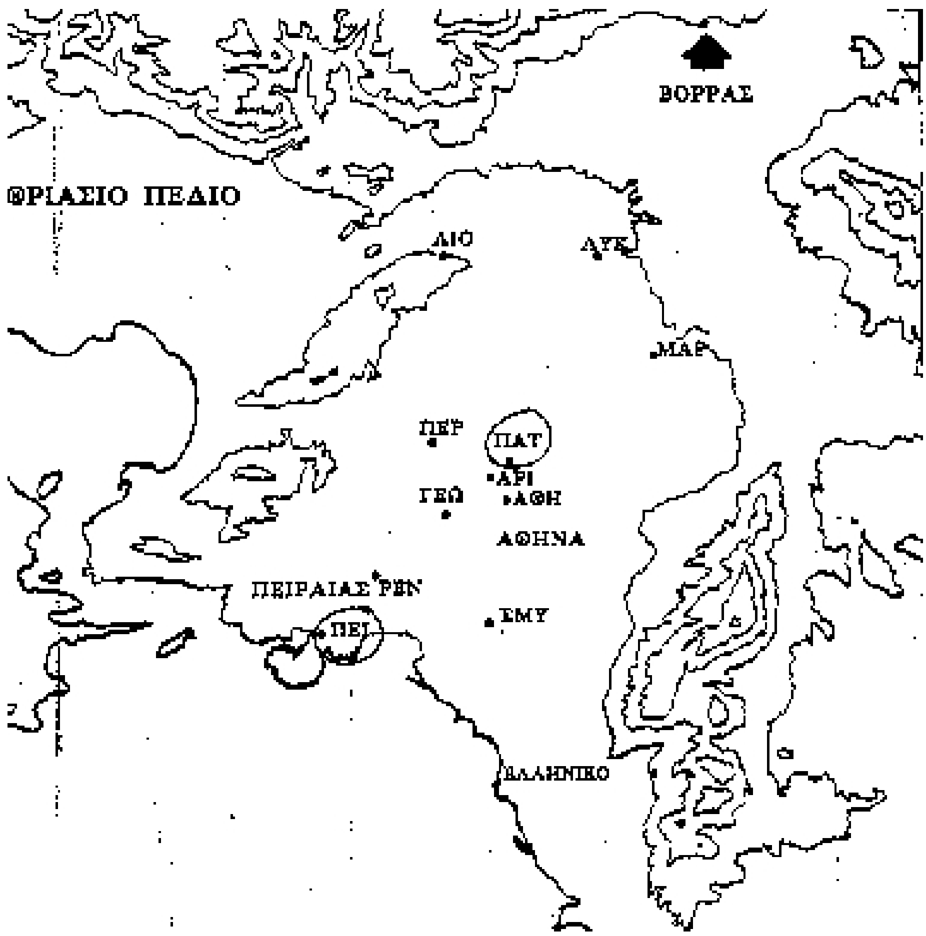
The Technical Report on the sources of air pollution (Ministry of Environment, Planning and Public Works, Division of Air pollution and Noise Control-PERPA, Technical Report, Athens 1989) indicates that 64% of black smoke comes from vehicles, 19% from industry and 17% from heating. Among the emissions from vehicles, 90% of smoke comes from diesel-powered buses, taxis and trucks. There are no diesel-powered private cars in Greece.

Exposure data

In 1996, six stations were measuring black smoke (BS). Two monitoring sites for BS were chosen, based on completeness criteria. These two stations on which the HIA is based are central and may be characterised as traffic stations, although they are not “kerb sites” (e.g. the Patision station is at 9 meters height). They measure with semi-automatic measurements methods and comply with the EC requirements for quality control.

For 1996:

- daily mean levels (SD) of BS were 65.9 µg/m^3 (29.6)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 32.6 µg/m^3 and 108.0 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 361 days
- number of days when BS exceeded 50 µg/m^3 was 235 days.



From: Ministry of Environment, Planning and Public Works, Directorate General for the Environment. Air Pollution in Athens 1994 Athens 1995. Scale: 1/100000.

Health data

We used the total daily number of deaths (excluding deaths from external causes ICD > 800) for people residing the Athens area. The data was provided by the National Statistical Service of Greece, following a specific request.

The standardised mortality rate for Athens using the European population as a reference (IARC 1982) is 784 per 100 000 inhabitants.

Health impact assessment

We consider only the short-term exposure or acute effects scenarios for black smoke since for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction by 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	235	332.4	167.5	441.0	10.8	5.4	14.4
20 µg/m³	361	733.5	371.8	969.3	23.9	12.0	31.5
By 5 µg/m³	NA*	81.2	47.4	115.0	2.6	1.5	3.7

**NA: not applicable*

Comments

The figures provided by the HIA may overestimate the actual number of attributable deaths in Athens due to the location of the monitoring sites that provide high measurements for black smoke compared to other stations.

The institution responsible for air quality monitoring and management is the Ministry of Environment, Planning and Public Works.

Athens has already taken many measures:

- About 10 years ago, a broad set of incentives was introduced to provide financial help to individuals who wanted to replace their old cars with cars with catalytic converters. The system operated for a limited number of years.
- Only half the cars circulate in the centre of Athens every working day
- Emission inspections every 3 years have been introduced for every car
- The Ministry of Environment, Planning and Public Works inspects heating systems and industries
- Buses that run on natural gas have been introduced
- The metro system started operating last year.

The impact of these measures has not been evaluated.

Today, most buses, all trucks and virtually all taxis still run on diesel fuel. However, private diesel-powered cars are not allowed in Greece.

Athens partners

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BARCELONA CITY REPORT

Background

With an area of 99.074 km^2 and 150 5581 inhabitants (in 1999), Barcelona is a city with a high population density (15 196.53 inhabitants per km^2). It has a Mediterranean climate. The mean annual temperature in 1999 was 17.3ºC, with a range between 1.4 and 31.4ºC. The mean barometric pressure was 1.012.8 hPA (range: 992.5-1028.3). Relative humidity is high with an annual mean of 77%. The total rainfall was 515.3 mm; it rained 72 days and 29 days were cloudy in 1999.

Within the context of the Apheis project, a steering committee and a technical committee have been created, with representatives of different agencies both local and regional. Local agencies are the Institut Municipal de Salut Pública (local authority of public health), the Direcció d'Iniciatives i Vigilància Ambiental (responsible for monitoring air quality), the Institut Municipal d'Investigació Mèdica (biomedical research). Regional agencies are the Department de Sanitat i Seguretat Social (regional authority of public health) and the Departament de Medi Ambient (regional authority of Environmental Quality). Moreover, some individual experts in the fields of environmental statistics, environmental epidemiology, and meteorology have been included in the technical committee. Results of the health impact assessment for total mortality, mortality for respiratory diseases (>65 years), cardiovascular mortality, and hospital admissions will be presented to these partners in order to help them make decisions based on this information.

Sources of air pollution

The main source of air pollution is traffic[1]. According to a study carried out in 1993, emissions from cars are responsible for 35% of particles, whereas other potential sources of pollution such as industry or combustion account for only 1%.

Exposure data

Pollution indicators are monitored by the Direcció d'Iniciatives i Vigilància Ambiental (DIVA). Only measurements from urban background monitoring stations that are geographically representative of the study area and are not directly influenced by local sources of air pollution have been selected.

Black smoke is monitored by seven manual stations (the method of measurement is normalised smoke). For manual stations we have one measurement per day. SO_2, NO_2, CO and O_3 are measured by five automatic stations. Methods of measurement are UV fluorescence (SO_2), chemilumisnescence (NO_2), infrared rays spectrometry (CO) and UV absorption. The daily mean value of one station is selected only if more than 75% of hourly values are available.

Meteorological indicators are also monitored by the DIVA. Data includes temperature, relative humidity and barometric pressure on an hourly basis for the stations at Collserola, Besòs, and Montjuïc.

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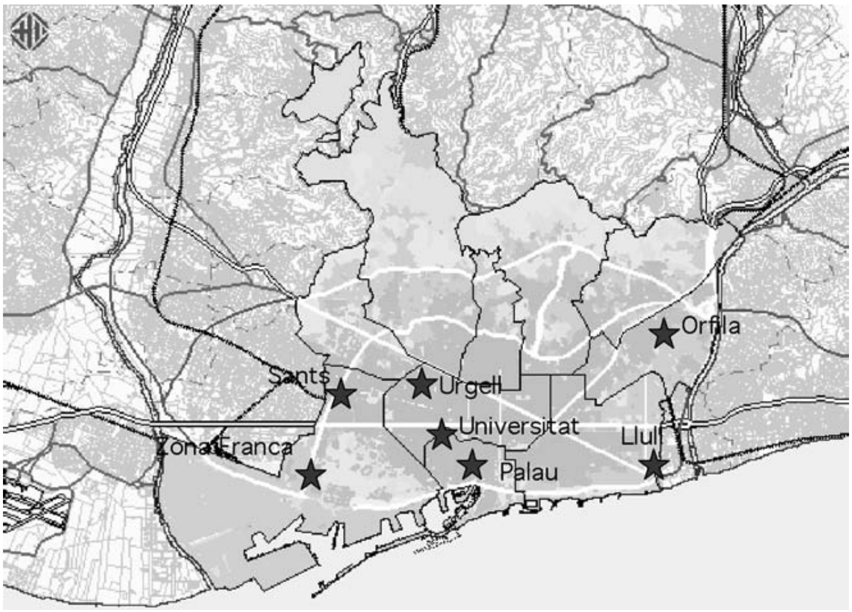
[1] Aceves M, Grimalt J. Large and small particle size screening of organic compounds in urban air. Atmosphere Environment 1993 27:251-253

For 1999:

- daily mean levels (SD) of BS were 32.9 µg/m³ (13.5)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 19.2 µg/m³ and 48.4 µg/m³
- number of days when BS exceeded 20 µg/m³ was 256 days
- number of days when BS exceeded 50 µg/m³ was 24 days.

Figure 1. **Location of monitoring stations for black smoke**



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Health indicators

Health data come from two different sources. Mortality data are provided by the Institut Municipal de Salut Pública and covers deaths of all residents, independent of place of death (for the HIA only deaths occurring in Barcelona have been selected), whereas hospital admissions data are provided by the Departament de Sanitat i Seguretat Social. They are coded with the ICD9.

Data on influenza incidence are provided by the Institut Municipal de Salut Pública.

The standardised mortality rate using the European population as a reference (IARC 1982) was 616 per 100 000 inhabitants.

Annual incidence of cardiovascular mortality was 366 deaths per 100 000 inhabitants per year.

Annual incidence of respiratory mortality was 120 deaths per 100000 inhabitants per year.

Daily mean of total mortality (1999) was 41 (SD=10).

Annual incidence of cardiac hospital admissions all ages was 514 admissions per 100 000 inhabitants per year.

Annual incidence of respiratory hospital admissions 65 years and older was 2 976 admissions per 100 000 inhabitants older than 65 years per year.

Health impact assessment

We consider only the short-term exposure or acute-effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

– for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
– for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
– for a reduction by 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	24	11.9	5.9	15.8	0.8	0.4	1.0
20 µg/m^3	256	119.0	59.7	158.3	7.9	4.0	10.5
By 5 µg/m^3	NA*	44.9	26.2	63.6	3.0	1.7	4.2

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	24	11.2	4.1	18.2
20 µg/m^3	256	111.5	40.9	180.8
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	24	1.2	0	11.7
20 µg/m^3	256	13.1	0	116.8

Comments

In 1999, 15 045 residents of Barcelona died in the city (ICD9<800). According to the HIA, if all the days above 20 µg/m^3 of BS were reduced to 20 µg/m^3, it would result in a decrease of 119 (0.8%) in the number of annual short-term deaths. The corresponding short-term reduction in hospital admissions for cardiovascular diseases would be 112 (1.5%) for cardiac diseases all ages, and 13 (0.1%) for respiratory diseases among the 65+ years group. But even a very small reduction in daily BS levels (5 µg/m^3) would result in a decrease in the number of short-term deaths (45 per year, in a range between 26 and 64).

Barcelona is also involved in the Spanish Project EMECAS, which includes 12 cities (described in the sections on Bilbao and other Spanish cities).

While levels of SO_2 have dramatically decreased in Barcelona in the last three decades, mainly thanks to new heating systems, levels of particles and NO_2 have not decreased as much.

A surveillance program of pollution sources has been initiated and is carried out by the DIVA. In 2000, 9 625 motor vehicles were inspected, and 2 963 were above the limit; 1 673 heating installations were also inspected, and 32 were above the limit.

The Barcelona City Council organises courses and seminars on ecology and environmental quality for both the general public and schools. There is a surveillance program on sources of air pollution with systematic inspection of combustion sources such as industries or domestic heating facilities, motor vehicles (using 10 stations, one in each district, that analyse emissions) and “classified activities”.

Valid data on PM_{10} has been available since 2001. The monitoring network is being modified according to the requirements of the framework and daughter Directives. In the future, there will be two background stations (one of them new, in Ciutadella) and four traffic stations (Eixample for very high traffic, Sagrera for high traffic, Sants for moderate transit, and Gràcia Sant Gervasi for low traffic). Additionally, the network will include a mobile station.

The Barcelona City Council has drafted the 21st Local Agenda in a process that has involved the participation of different social and business entities.

Barcelona partners

Steering committee

Antoni Plasència, Joan Guix – Institut Municipal de Salut Pública de Barcelona – coordinator
Pau Rodríguez. Departament d’Iniciatives i Vigilància Ambiental (Ajuntament de Barcelona)
Montserrat Solé. Departament de Medi Ambient (Generalitat de Catalunya)
Eduard Mata. Departament de Sanitat i Seguretat Social (Generalitat de Catalunya)
Josep Maria Antó. Institut Municipal d’Investigació Mèdica

Technical committee

Lucía Artazcoz – Institut Municipal de Salut Pública de Barcelona – coordinator
José Gracia. Departament d’Iniciatives i Vigilància Ambiental (Ajuntament de Barcelona)
Elvira Tornè. Àrea de Planificació del Consorci Sanitari de Barcelona
Experts: Marc Sáez, Jordi Sunyer, Jordi Vila, Dolors Carrascal

BILBAO CITY REPORT

Background

The Greater Bilbao Area (Basque Country, Northern Spain) has approximately 890 000 inhabitants (16.4% older than 65 years) and comprises Bilbao and neighbouring municipalities on both banks of the Nervion river overlooking the Bay of Biscay.

The climate is oceanic, with high rainfalls and mild winters; sea-land and land-sea local breeze are the predominant winds. In 1999 the mean minimum temperature was 9.9 °C and the mean maximum temperature was 19.3 °C; the relative humidity was 75.0%.

In this study, we have included the following municipalities in the Bilbao Metropolitan Area: Bilbao, Barakaldo, Erandio, Leioa, Portugalete, Sestao and Santurtzi, with a total population of 647 761; the population over 65 years is 106 167. The total area is 105 km^2. Bilbao is the biggest town with 41.3 km^2. The population density of the study area is 6 171.4 inhabitants/km^2; the most heavily populated is Portugalete with 16 897.2 inhabitants/km^2, whereas Erandio is the least populated (1 349.3 inhabitants/km^2). These municipalities were selected because they make up one urban area, affected by the same pollution and meteorological phenomena.

Sources of air pollution

Although in the past industry was the most important source of air pollution with very high levels of SO_2, since the 1990s vehicle traffic has become a very important source in the Metropolitan Area of Bilbao.

Exposure data

In the Metropolitan Area of Bilbao the pollution indicators are measured by an automatic network, managed by the Environment Department of the Basque Government, and a manual network, managed by the Public Health Directorate. PM_{10} (one station) data come from the automatic networks, corresponding to year 2000, whereas BS data are from the manual network and are from 1998. These were the last available data for the study. Since 2001 two PM_{10} monitoring stations were installed, so better data will be available in the near future.

Apheis guidelines on exposure assessment were fulfilled. The monitoring stations were selected for the study if more than 75% of hourly values were available. All of them are representative of the area, are situated in residential settings and are not directly influenced by local sources of air pollution. A map of the monitoring stations is given below.

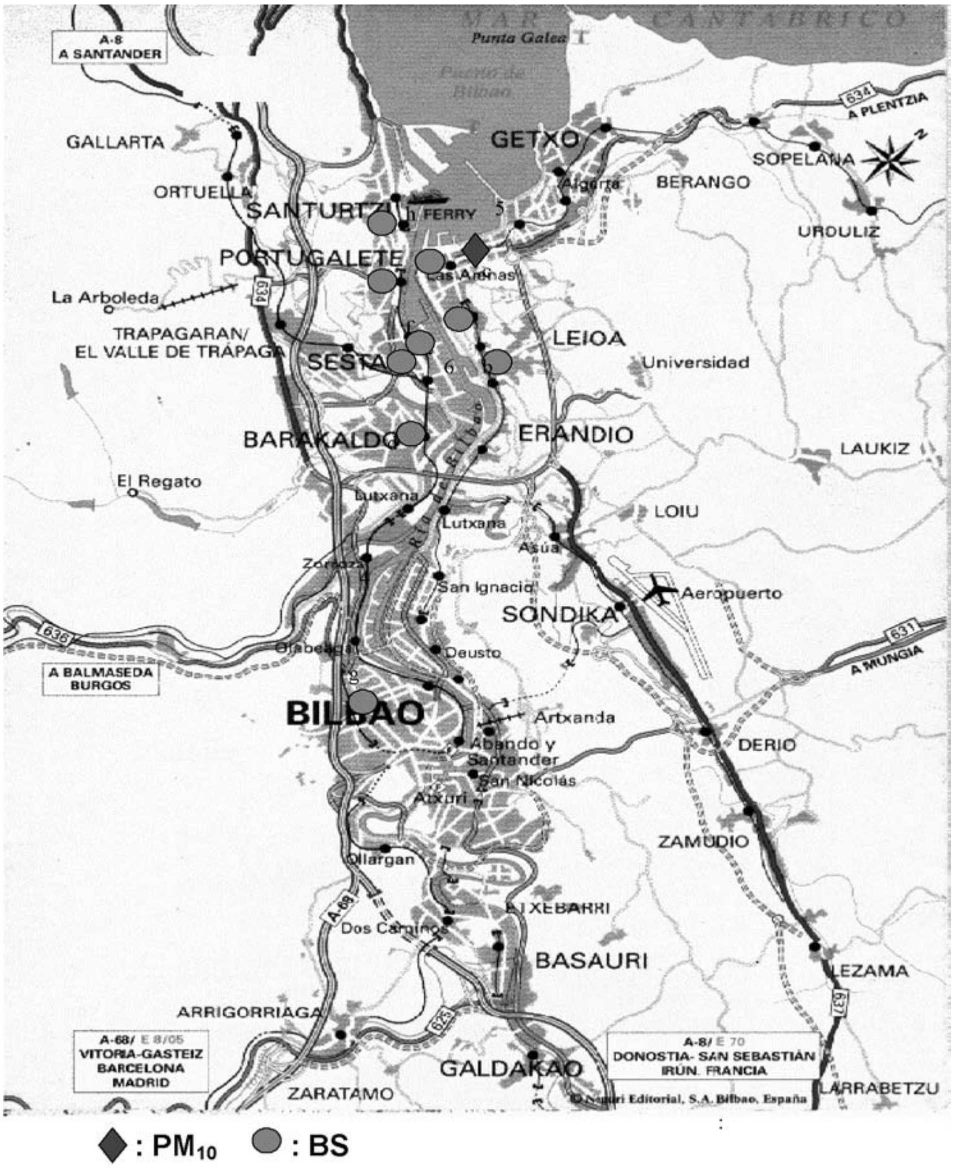
For 1998:

- daily mean levels (SD) of BS were 18.4 µg/m^3 (10.7)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 7.8 µg/m^3 and 32.9 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 119 days
- number of days when BS exceeded 50 µg/m^3 was 5 days.

For 2000 (PM_{10} data not used for the core HIA):

- daily mean levels (SD) of PM_{10} were 33.2 µg/m^3 (15.4)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 15.6 µg/m^3 and 55.8 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 300 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 67 days.

Figure 1. **Map of Bilbao Area and monitoring Station**



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Health data

The number of daily deaths for all causes excluding external was provided by the Mortality Register of the Basque Autonomous Community using the international classification of diseases (ICD9, 001-799).

The age standardised mortality rate using the European population as a reference was 630 per 100 000 inhabitants.

Hospital admissions data came from the Hospital Discharge Register of the Basque Autonomous Community, and they were also coded using the ICD9. We used only urgent admission data from the Hospitals of the Basque Health Service, which represent more than 98% of the total urgent admissions in the area.

In 1998, the daily mean number (and SD) of respiratory hospital admissions 65 years+ was 7.8 (4.7). The corresponding incidence rate was 2 665.6. For 2000, these numbers were respectively 8.7 (5.9) and 3 000.2.

The daily mean number (and SD) of cardiac admissions all ages (ICD9 460-519) for 1998 was 7.1 (3.2). The corresponding incidence rate was 400.5. For 2000, these numbers were respectively 7.2 (3.2) and 407.5.

We have used both mortality and urgent admission data to assess BS in 1998.

Health impact assessment

We consider only the short-term exposure or acute-effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

– for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
– for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
– for a reduction by 5 µg/ m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	5	0.5	0.2	0.6	0.1	0.0	0.1
20 µg/m^3	119	11.1	5.5	14.7	1.7	0.8	2.3
By 5 µg/m^3	NA*	15.0	8.8	21.3	2.3	1.4	3.3

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	5	0.4	0.2	0.7
20 µg/m^3	119	10.4	3.8	16.9
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	5	0.0	0.0	0.4
20 µg/m^3	119	1.1	0.0	9.2

Comments

The industrialisation of the Bilbao area, based mainly on iron and steel production, began at the end of the 19th century and experienced rapid growth during the decade of the 60s. During the 70s and early 80s, the industrial emissions were responsible for very high pollution levels, with annual average levels of SO_2 up to 250 µg/m^3; BS levels were 40 µg/m^3 by the mid 80s.

In 1977, the greater Bilbao was declared an "air polluted area" and a clean-up plan aimed mainly at reducing industrial emissions came into force. The measures taken included financial aids, introduction of new and cleaner technology, and changes in processes and fuels; a complete, automatic air-quality network was also established. In the 90s, pollution levels decreased dramatically, and in 2000 suspension of the "air polluted area" was approved.

The health effects of air pollution were studied in the Metropolitan Area of Bilbao in the late 90s, by the EMECAM project (Spanish Multicentre Study on the Relationship Between Air Pollution and Mortality). It was found that increases in total suspended particles (TSP) were significantly associated with increases in the daily number of deaths from all causes and from circulatory causes. Results from Bilbao also suggested a possible association between NO_2 and mortality from respiratory causes.

In 1998, levels of black smoke from the Bilbao area were moderate. Hence, the number of associated health events, such as deaths and hospital admissions, was not high. The annual number of deaths brought forward by air pollution levels higher than 20 $\mu g/m^3$ was 11.1 (CI: 5.5-14.7), the number of attributable cardiac hospital admissions was 10.4 (CI: 3.8-16.9) and the equivalent for respiratory admissions among those over 65 years old was 1.1 (CI: 0.0-9.2).

A further reduction in BS level may still have health benefits. According to this evaluation, even a reduction of BS levels by 5 $\mu g/m^3$ would prevent 15 deaths per year from being brought forward. Besides, this figure is only related to short-term effects. Though there have been no reliable RR estimates yet, long-term health effects of BS may be important, as they have been proved to be for related pollutants such as PM_{10}.

One key question in HIA is the extent to which environmental data represent the actual exposure of the population. That may be especially important for BS measurements since they are directly influenced by the traffic closest to the monitoring station.

Experimentally, we conducted an HIA on PM_{10} data for 2000. Health effects attributable to PM_{10} seem to be higher than for BS. However, this finding must be viewed with caution, because air pollution data came from only one monitoring station and they may not properly represent the average exposure of the residents in the Bilbao area. In 2000, among people over 65 years, hospital respiratory admissions attributable to PM_{10} daily concentrations above 20 $\mu g/m^3$ were 44.6 (CI: 29.9-63.9) and those due to a cardiac cause (all ages) were 20.7 (CI: 8.4- 32.9).

Bilbao partners

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BORDEAUX CITY REPORT

Background

The city of Bordeaux is situated near the Atlantic Ocean. The study area includes 18 municipalities. In the last census of population (1999), these municipalities represented a total of 584 164 inhabitants. They are distributed over an area of about 283 km^2, which represents a density of 2 064 inhabitants/km^2. Bordeaux has an oceanic climate and average temperature ranging from 9.3°C to 18.7°C. Relative humidity is 54.9%, and the annual rainfall varies around 950 mm.

Sources of air pollution

78.1% of the emissions of nitrogen oxides (NO_x), 83.7% of carbon monoxide (CO) and 50.5% of volatile organic compounds (VOC) came from traffic sources. For sulphur dioxide (SO_2) and ammonia (NH_3), the industry and the treatment of waste are the main sources of air pollution, respectively 54.3% and 79.3%. In the Aquitaine region, a decrease in all emissions, except for NOx which increased by 9% over this period, was observed between 1990 and 1994. It should be noted that these statistics did not include particles, measured only from 1997 for the city of Bordeaux *(source: CITEPA 1994).*

Exposure data

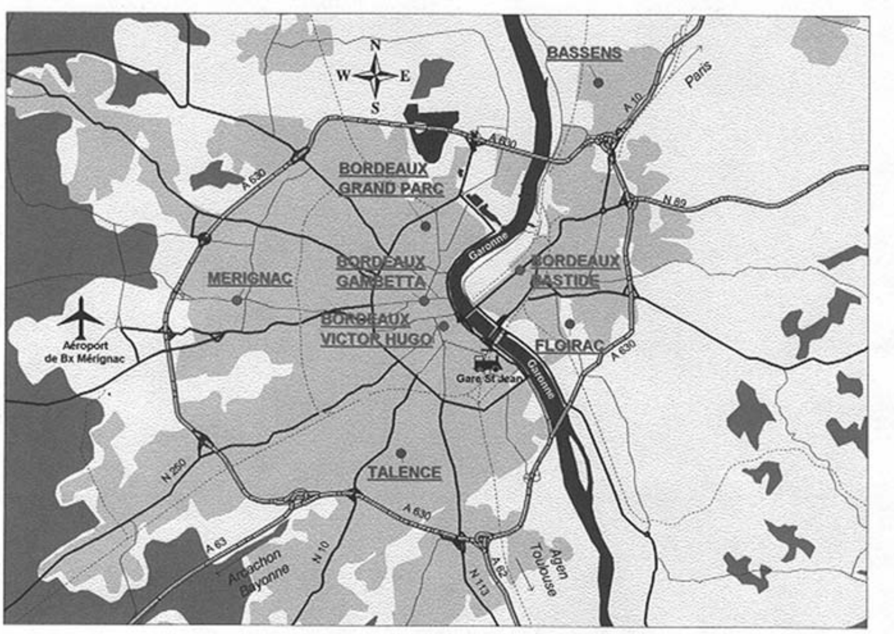
Black smoke (BS) has been measured since 1976 for the city of Bordeaux, and four monitoring sites were chosen according to the exposure guidelines of the Apheis protocol. The air pollution network AIRAQ has been responsible for measuring PM_{10} since July 1997. The data selected for the HIA are those measured over the year 2000 by four selected urban and suburban stations (i.e. stations not directly influenced by industrial or road-traffic sources of pollution). Over this period, the daily levels of air pollutants recorded by these stations were correlated (correlation $\geq$ 0.90) and have close mean levels of pollution. The PM_{10} exposure indicator was constructed by calculating the arithmetic mean of daily concentrations recorded by these four stations. When one or several daily data were missing for one or both stations (more than 25% of data missing over the 24 hours), they were automatically replaced.

Meteorological data (temperature and humidity) have been provided by Météo-France for all the PSAS-9 cities.

For 1997:
- daily mean levels (SD) of BS were 15.3 µg/m^3 (10.2)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 5.5 µg/m^3 and 30.6 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 100 days
- number of days when BS exceeded 50 µg/m^3 was 2 days.

For 2000:
- daily mean levels (SD) of PM_{10} were 20.1 µg/m^3 (10.1)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 10.3 µg/m^3 and 32.4 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 144 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 7 days.

Air pollution monitoring sites are shown below (source AIRAQ).



Health data

Mortality data was collected by the service of information on medical causes of death (SC8) of the INSERM (National Institute of Health and Medical Research). The daily number of deaths for every city corresponds to the total non-accidental mortality: codes ICD9 < 800. The main cause of death was used for the selection procedure.

The age-standardised mortality rate for Bordeaux using the European population for reference was 497 per 100 000 inhabitants.

Hospital admission data were collected by the Department of Medical Information (DIM) of 4 public hospitals in the area studied. The daily numbers of respiratory hospital admissions (ICD9 [460 - 519]; ICD10 [J00 - J99]) among patients 65 years + were taken from the "Programme de Médicalisation des Systèmes d'Information" (PMSI) information system.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 was 2.9 (2.1). The corresponding incidence rate was 3.1 per 100 000 inhabitants, equivalent to 1 146.8 per 100 000 per year.

No data was available for cardiac admissions all ages (ICD9 410-414,427,428).

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute-effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction by 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m3, above 20 to 20 µg/m3 and all days by 5 µg/m3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m3	2	0.1	0.0	0.1	0.0	0.0	0.0
20 µg/m3	100	7.7	3.8	10.2	1.3	0.7	1.7
By 5 µg/m3	NA*	13.2	7.7	18.7	2.3	1.3	3.2

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m3 and above 20 to 20 µg/m3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m3	na*	na	na	na
20 µg/m3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m3	2	0.0	0.0	0.0
20 µg/m3	100	0.3	0.0	2.3

** na: not available*

PM_{10} scenarios

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m3 to 50 µg/m3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m3 to 20 µg/m3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m3 in the 24-hour daily values of PM_{10} (to allow for cities with low levels of PM_{10})

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m3, above 20 to 20 µg/m3 and all days by 5 µg/m3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m3	7	0.3	0.2	0.4	0.1	0.0	0.1
20 µg/m3	144	11.3	7.5	15.0	1.9	1.3	2.6
By 5 µg/m3	NA*	13.6	9.0	18.2	2.3	1.5	3.1

**NA: not applicable*

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m³	na*	na	na	na
20 µg/m³	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	7	0.1	0.1	0.2
20 µg/m³	144	4.0	2.7	5.8

** na: not available*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10})

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m³, and by 5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m³	1.9	1.1	2.6	0.3	0.2	0.4
10 µg/m³	183.9	111.2	257.8	31.5	19.0	44.1
By 5 µg/m³	92.0	55.9	128.4	15.7	9.6	22.0

Comments

From the measurements made in the study area of Bordeaux, it was observed that PM_{10} concentrations were above the limit values set by the guidelines for 2005 and 2010. Nevertheless, even a small reduction in the PM_{10} level (5 µg/m³) leads to a significant decrease in the number of long-term deaths.

The last available year for BS data was 1997, so we used the 1997 health data (mortality and hospital admissions). For PM_{10}, the last available year was 2000. The 1998 mortality data was used for PM_{10}.

The French regulations to monitor air pollution and its health effects, and the steps planned to reduce air pollution levels, are described below but concern all the cities involved in the PSAS-9 programme.

Links between air pollution regulations, PRQA, PDU, and PSAS-9 for all the PSAS-9 cities

Creation of the PSAS-9 programme in June 1997 is very much linked to the law on air and the rational use of energy passed on 30 December 1996. This law gives the French governement responsibility for monitoring not only air quality but also its effects on health. To do so, objectives are set for air quality in accordance with those defined by the European Union or by WHO, and must be updated regularly according to the findings of epidemiological studies.

In each region, the prefect works out a regional policy for air quality, called Plan Régional de la Qualité de l'Air (PRQA), in order to reach the air quality objectives previously set and presents the main aspects of his regional policy. To do so, the PRQA draws on an inventory of emissions and air quality as well as on an assessment of their effects on health. Each PRQA must be evaluated and, if necessary, revised 5 years after its publication.

Concurrently, a policy on air protection, called Plan de Protection de l'Atmosphère (PPA), is developed in each metropolitan area of more than 250 000 inhabitants. The PPA, also drawn up by the prefect, aims to define the actions that can be taken to reach the objectives of air quality: operating rules of some installations, use of fuel, use of cars, and frequency of inspection of emissions from installations, among others. The PPA is also revised every 5 years.

Finally, a policy on urban transports, called Plan de Déplacements Urbains (PDU) has been implemented for metropolitan areas of more than 100 000 inhabitants. It sets rules for the organisation of transport of goods and populations, for traffic and parking. Its aim is to foster a balance between the use of vehicles and easy access on the one hand, and the protection of health and the environment on the other. The PDU is implemented by the institute responsible for the local organisation of urban transport.

An epidemiological tool for the health impact assessment of air pollution became essential in order to enforce this law. The InVS suggested implementing a standardised and transparent method, based on a risk analysis approach, that would allow health impact assessment of air pollution from existing data collected on a daily basis.

At the time, there were very few exposure-response functions available for these health impact assessments in France. Only results of epidemiological studies for the agglomeration of Paris (ERPURS study) and Lyon could be found, without any certainties that exposure response functions were similar in the various other French agglomerations encountered, being potentially different in terms of geographic, sociodemographic or emission-source characteristics. The main objective of the PSAS-9 programme was therefore to produce short-term exposure response functions standardised for the nine French cities involved in the programme, and to produce also combined relative risks for mortality indicators. These meta-risks could then be applied to other cities that were not part of PSAS-9, allowing short-term health impact assessments of urban air pollution as part of the PRQA.

As part of the PRQA, recommendations were made to encourage the improvement of air quality at the regional level. As such, an inventory of all the sources of emissions of particles is to be made and several recommendations are in favour of a reduction of the emissions from the sources of particles: the use of appropriate technologies, encourage other means of transportation than automobiles, develop group transport, enforce the rules on emissions from vehicles etc.

Bordeaux partners

Laurent Filleul – InVS- coordinator

I Baldi (Institut de Santé Publique, d'Epidémiologie et de Développement),
E Capdenat (DIM Hôpital du Bouscat),
M Charron (DDASS Gironde),
JP Chassaigne (DIM Hôpital Bagatelle),
P Denis (DIM Clinique Mutaliste de Pessac),
V Gilleron (SIM-CHU Bordeaux),
P Grégoire (AIRAQ),
B Léglise (SOS-Médecins),
JL Zulian (AIRAQ),
FX Jouteux (DRASS Aquitaine).

BUCHAREST CITY REPORT

Background

The Bucharest metropolitan area has a population of roughly 2 million people with a proportion of 13% of people older than 65 years. The city is divided in 6 administrative sectors (1-6). It is at a latitude of 44.45 and a longitude of 26.17. Its altitude is 85 meters. It covers an area of 238 km^2 with a population density of 8,521 inhabitants/km^2.

It has a temperate climate. For the mid 90s (1992-1996), the mean annual temperature was 11°C, its mean daily temperature ranging from -11°C to 29°C and its relative humidity ranging from 38% to 100% (with a mean of 73.7%). In 1998, the absolute minimum temperature was –15.6 °C and the absolute maximum temperature 40.4°C (source: National Institute of Meteorology and Hydrology).

Sources of air pollution

In the past, there were several industrial sites in the outskirts of Bucharest that were heavily polluting. Yet, in the past ten years, as production declined and some of the industrial areas shut down, the main source of pollution became traffic and the combustion plants for central heating, as well as individual heating systems. The percentage of emissions from industry/heating and traffic in 1996 were respectively 27%, 32% and 41% (source: Ministry of Environment).

Exposure data

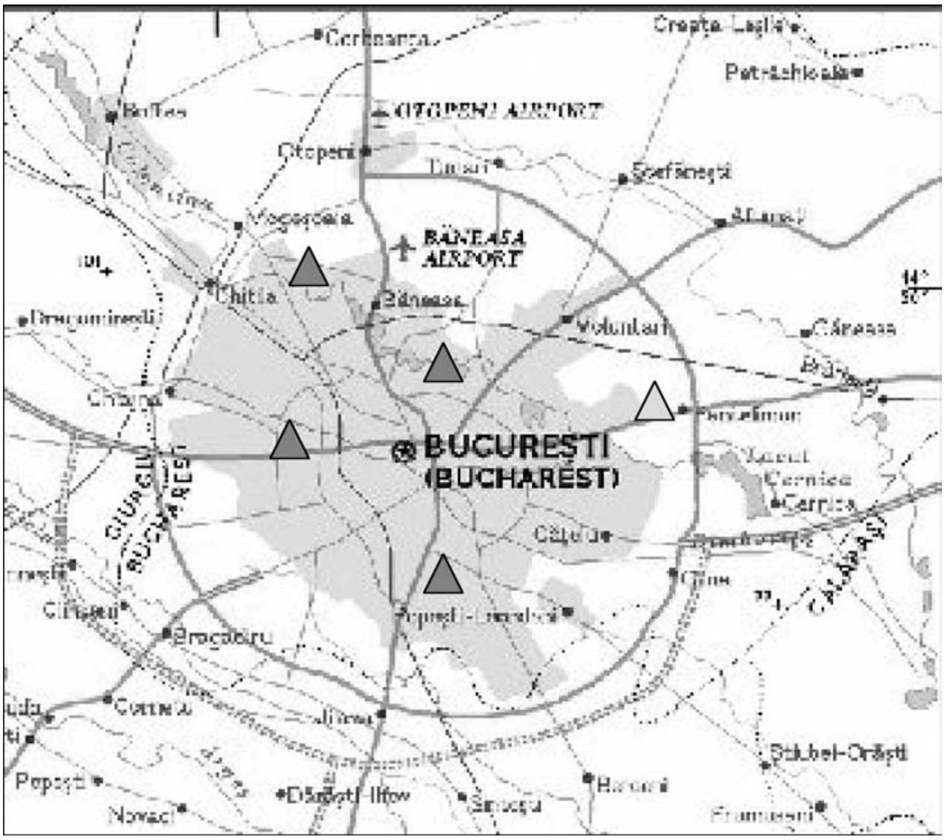
The pollution indicators provided are measured by the Network of the Ministry of Health and Family. For 1999, measurements were performed at five locations. Four of them are represented in the Apheis study, these being generally a combination of background and traffic measurements. The monitoring stations are geographically representative of the study area. 24 hours TSP was measured. TSP was converted to PM_{10} using on a conversion factor of 0.6.

Measurements are 24h, gravimetric, four days a week, Monday to Thursday, and there are no measurements on Fridays and weekends. This can lead to an overestimated yearly mean air pollution level, as during weekends air pollution levels tend to be lower due to reduced traffic and industrial activity in the city.

For 1999:

- during 188 days (4 working days per week in a year), daily mean levels (SD) of PM_{10} were 73 µg/m^3 (13)
- during 188 days, the levels of PM_{10} reached in the days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 58.9 µg/m^3 and 86.1 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 187 days out of 188 days (4 working days per week)
- number of days when PM_{10} exceeded 50 µg/m^3 was 178 days out of 188 days (4 working days per week).

The Bucharest air pollution network is presented below.



Network of the Ministry of Health:

sites included in Apheis with TSP measurements in 1999

sites not included in Apheis (outside the administrative area of the Municipality of Bucharest, industrial zone)

Health data

The mortality and morbidity (hospital admissions) data are provided by the National Statistics Commission and by the Medical Statistics Centre of the Ministry of Health and Family. The codes are based on the international classification of diseases (ICD9).

The standardised mortality rate of Bucharest using the European population as a reference (IARC 1982) is 1 127 per 100 000 inhabitants.

In 1999, the daily mean number of hospital admissions for respiratory diseases in patients older than 65 years is 15.5. Due to differences with the health care system, cardiac admissions are not reported.

Health impact assessment

According to the PEACE project [1], PM_{10} levels generally vary little between weekdays and weekends, on the order of –5% to -7%. But during PM_{10} European measurement campaigns, experts consider

[1] Hoek G, Forsberg B, Borowska M, Hlawiczka S, Vaskövi H, Welinder H, Branis M, Benes I, Kotesovec F, Hagen LO, Cyrus J, Jantunen M, Roemer W, Brunekreef B. Wintertime PM_{10} and Black smoke concentrations across Europe: results from the PEACE study *Atmospheric Environment* 1997;31:3609-3622.

that the PM_{10} concentration on weekends (Saturdays and Sundays) is 30% lower than from Mondays to Fridays. For Bucharest the annual mean for 1999 is 73.0 µg/m^3 (measurements from Monday to Thursday). According to the experts, because Fridays should also be considered (due to industrial and pre-weekend traffic activities on Fridays) the "weekend reduction" should be smaller, around 20% to 25%, which means that the missing values should be replaced by 55 µg/m^3. Instead, we replaced PM_{10} missing values by an average value of 40 µg/m^3, applying an "at least" conservative approach.

Replacing all the days with missing values by an average value of 40 µg/m^3 the air pollution levels during a 1-year period in Bucharest become the following:
- daily mean levels of PM_{10} would be 56.9 µg/m^3 (SD: 18.9)
- the levels of PM_{10} hypothetically reached on the days with the lowest (10th percentile) and the highest (90th percentile) levels would be respectively 40 µg/m^3 and 82 µg/m^3
- the number of days when PM_{10} would exceed 20 µg/m^3 would be 364 days
- the number of days when PM_{10} would exceed 50 µg/m^3 would be 178 days.

For PM_{10} measurements we developed the short-term and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to particle air pollution on mortality and hospital admissions over one year:
- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to take into account countries with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	178	160.1	107.0	213.0	7.9	5.3	10.5
20 µg/m^3	364	501.9	337.2	664.1	24.7	16.6	32.7
By 5 µg/m^3	NA*	66.5	44.1	88.9	3.3	2.2	4.4

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	178	na*	na	na
20 µg/m^3	364	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	178	62.8	42.0	90.2
20 µg/m^3	364	195.3	131.7	277.9

** na: not available*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to particle air pollution on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}). Under this scenario the mean annual PM_{10} level for Bucharest in 1999 was estimated as being 57 µg/m^3.

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 40, 20 and 10 µg/m^3, and by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	1 493.2	897.6	2 105.7	73.6	44.3	103.8
20 µg/m^3	3 118.4	1 843.1	4 473.7	153.8	90.9	220.6
10 µg/m^3	3 881.1	2 274.2	5 617.0	191.4	112.1	277.0
By 5 µg/m^3	450.1	273.3	628.4	22.2	13.5	31.0

Comments

Air pollution remains a public health problem in Bucharest. We assigned a 40 µg/m^3 value to the days with missing values using an “at least approach”, which is conservative but gives an idea of what the potential “at least” health benefits would be of reducing PM_{10} levels in Bucharest, allowing an “at least” comparison with the other Apheis cities.

In the last 3 years special attention was paid to assessing the health impact of air pollution on health through the National Environmental Health Action Plans (NEHAPs). Legislative activity has also been taking place in the last few years towards a harmonisation of the European Union (EU) environmental legislation with Romania’s national legislation as part of Romania’s intergration with the European Union.

HIA will be one of the important activities that will support this process and of which aim is to improve air quality in Bucharest.

Bucharest partners

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Dr. Vasile Frunza, Chem. Gabriela Mitroi, Chem. Irina Roman – collaborators – Institute of Public Health Bucharest

Collaborating institutes:

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Medical Statistics Center of the Ministry of Health and Family – Dr Liviu Botezat

Further contacts: Municipality of Bucharest, Environmental Protection Inspectorate Bucharest, National Institute of Hydrology and Meteorology.

BUDAPEST CITY REPORT

Background

Budapest covers an area of 524 km^2 with less than two million inhabitants. The percentage of the population above 65 years is 17.5%. The city is located along the Danube River, divided in 23 administrative sectors, 6 in Buda and 17 in Pest. It is at a latitude of 47.5°, and a longitude of 19.1°. Its altitude is 105 m. The population density is 3 388.525 inhabitants/km^2.

Budapest has a continental climate, the prevailing wind direction is north-west. The yearly mean temperature was 12.8°C, the yearly average of daily minimum temperature was 8.1°C, and the maximum was 17.1°C in 1999. The mean rainfall varied from 30 to 65 mm/month, the rainier months are the summer months (June-August) and November. Budapest has 200-250 hours of sunshine per month between May and September, and 50-100 hours per month in the winter. The mean annual windspeed is 4.8 km/h, the maximum windspeed (averaged over 8 stations) is 17.9 km/h. The geographical location of the city - the river Danube, the hilly part on the right side and the flat part on the right side - ensures good ventilation of the city.

The main activities in the city are administrative, business, commercial. With its three railway stations and the only international airport in the country, Budapest is also a traffic centre. The four national motorways, constructed in a radial pattern, have their starting points in Budapest and are interconnected partly through ring-road M0. Csepel (also part of Budapest) operates a freight port on the Danube. Most of the country's higher education and research institutions are located in Budapest. Manufacturing activities in Budapest have been shrinking for decades and are being gradually replaced by the service industry. In fact, the manufacturing activities and the related repair, commercial and catering services are a minority in Budapest (i.e. less than 40%).

Sources of air pollution

The main source of air pollution in general is traffic. According to a study carried out in 1997 the emissions coming from cars are responsible for 13% of particle emissions, whereas other potential sources of pollution, such as industry or combustion, are responsible for the remaining ratio of particulate pollution. The percentage of emissions from industry and heating in 1997 were respectively 80% and 7% (source: Ministry of Environment).

Exposure data

The pollution indicators are monitored by the Municipal Institute of Public Health Service, Capital Budapest. The network of online monitoring system was established in 1992. It consists of eight stations, five of them measure residential-commercial type pollution, and three measure residential type of pollution. Each station measures TSP, the average of the concentration of the eight stations was used in this analysis.

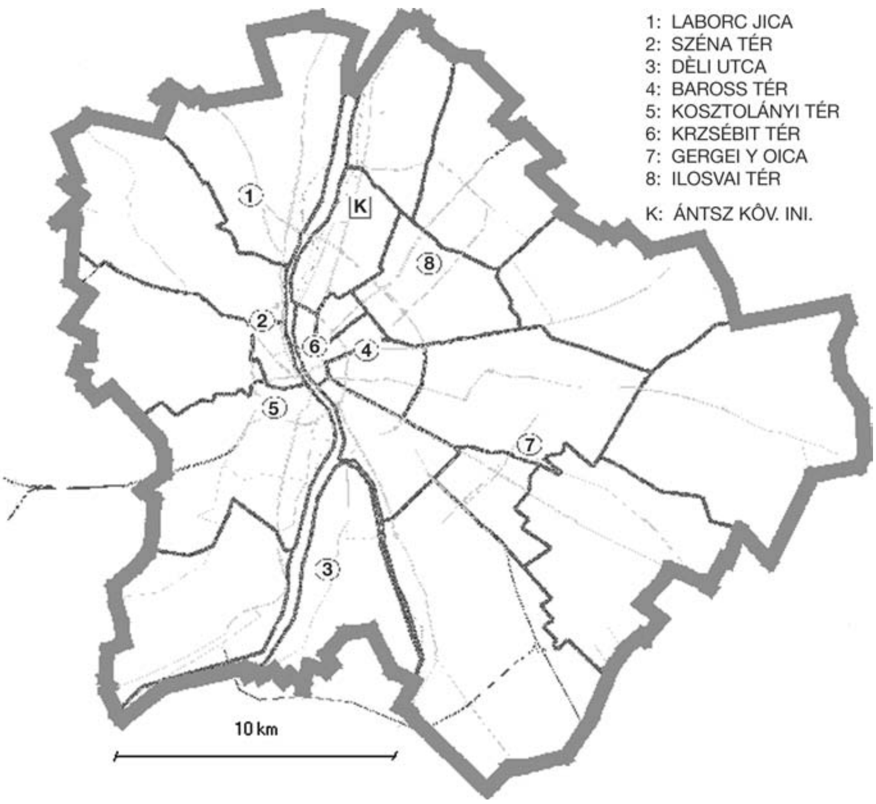
TSP is monitored by eight on-line automatic stations (the method of measurement is beta-ray). SO_2, NO_2, CO are measured by eight automatic stations, and O_3 is measured by two automatic stations. The methods of measurement are UV fluorescence (SO_2), chemilumniscence (NO_2), infrared rays spectrometry (CO) and O_3 UV absorption. When calculating the health impact of particulate matter a correlation factor of 0.58 was used for PM_{10} based on a regression analysis of one year parallel measurement of TSP at two stations and PM_{10} by one station situated between the two other stations. TSP mean concentration was calculated as a 24-hour mean of the eight monitoring stations.

For 1999:

- daily mean levels (SD) of PM_{10} were 29.5 µg/m^3 (11.3)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 16.2 µg/ m^3 and 45.2 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 289 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 16 days.

Air pollution network is given in map below.

	List of monitoring stations	Station type	type of zone	characteristic
1	Laborc street	background	urban	residential
2	Szena square	traffic	urban	residential/ commertial
3	Déli street	industrial	urban	residential/ commertial
4	Baross Square	traffic	urban	residential/ commertial
5	Kosztolanyi Square	traffic	urban commertial	residential/
6	Erzsebet Square	traffic	urban commertial	residential/
7	Gergely Square	background	urban	residential
8	Ilosvai Square	background	urban	residential



The meteorological indicators are also monitored by the on-line monitors automatically. The data includes temperature, relative humidity, wind speed and wind direction on a 30 minutes basis for each station and barometric pressure measured in one station.

Health data

The total daily number of deaths (excluding deaths from external causes ICD9> 800) for residents of Budapest was used.

The standardised mortality rate in Budapest using the European population as a reference (IARC 1982) is 1 021 per 100 000 inhabitants.

Mortality data were given by the Central Statistical Office using ICD 10 since 1996.

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

– for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
– for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
– for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	16	7.1	4.7	9.4	0.4	0.3	0.5
20 µg/m^3	289	173.1	115.7	230.3	9.7	6.5	13.0
By 5 µg/m^3	NA*	82.7	54.9	110.6	4.7	3.1	6.2

**NA: not applicable*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

– for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
– for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
– for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
– for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 2 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 2. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	1 053.3	637.1	1 476.0	59.3	35.9	83.1
10 µg/m^3	2 117.4	1 270.2	2 992.2	119.2	71.5	168.5
By 5 µg/m^3	559.6	339.8	781.2	31.5	19.1	44.0

Comments

The results of the health impact assessment show the benefits of reducing particulate matter exposure. Although the PM_{10} yearly mean was 29.5 µg/m^3, 289 days exceeded 20 µg/m^3, and this was associated with more than 170 short-term deaths per year that could be prevented. The benefits are much higher for long-term exposure to PM_{10}. Even a PM_{10} reduction of 5µg/m^3 would lead to a decrease in the number of long-term deaths by more than 500 per year, including more than 80 short-term deaths.

The mean particulate matter concentration shows a decreasing tendency; in 1992 TSP concentration started from 71 µg/m^3, in 1997 it was 58 µg/m^3, in 1998 it decreased to 51 µg/m^3. This decrease is partly due to the decreasing tendency of particulate emissions of industrial origin.

During the mid-90s, some measures were already introduced for the improvement of air quality, among others the building of the M0 ring road in the outskirts of Budapest in order to direct the lorry traffic away from the centre of the capital. The volume of traffic caused by the use of personal cars has been reduced by introducing parking zones in the downtown with high parking fees. However, the major type of vehicles used in public transportation is bus, its number is roughly half of the total number (3 132) of all vehicles (trams, trolley buses, metro and suburban railway). Buses are diesel operated. In the last two/three years the old type buses have been replaced by “environment-friendly” new type vehicles on the most frequently used lines. No gas-operated buses are in use in Budapest.

The running kilometres of public transportation showed a decreasing tendency from 228 985 km in 1990 to 181 736 km in 1999. The number of trucks registered in Budapest was 66 728 in 1999, 31% of them were petrol operated and 69% diesel operated, the average age of the trucks was 7.95. On the other hand, the number of private cars is increasing.

In 1999, there were 559 100 private cars, 311 per 1 000 inhabitants, while there were only 63 motorcycles per 1 000 inhabitants. 91% of private cars used petrol, and only 9% diesel. The average age of the cars was 9.5 years, which involved a shortage in the technological status of the cars. Although compulsory emission inspection has been introduced, every three years then every two years, for cars less than 9 years old, and every year for cars over 15 years old, this measure does not guarantee the prevention of air pollution produced by old cars.

Further measures have been introduced to reduce particulate emission from traffic, e.g. the technical inspection of cars should be strengthened taking into consideration the mean age of cars. Some preventive measures on vehicle exhausts were introduced in the mid 90s, e.g. cars supplied with a catalytic converter now get a 50% reduction in “weight” tax. As a consequence of health impact assessments such as the one carried out by Apheis, decision-makers have to consider further possible ways of reducing traffic-related air pollution.

The NEHAPS in Hungary puts a special effort on assessing the health impact of air pollution in Budapest. Within the process of the European Integration of Hungary, this health assessment correlates with the legislative activity that aims to harmonise the EU environmental legislation with the national one. Our HIA should highly support this process and should help improve air quality in Budapest. Apheis will update the health impact of air pollution over time. These results should serve as a basis for policy-making in the future.

Budapest partners

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CELJE CITY REPORT

Background

The Celje metropolitan area has a population of roughly 50 000 people. The number of people over 65 years is 7 000 (14%). Due to its location, it is one of the coolest towns in the country. Its climate is a transition between a continental and an alpine climate, with prevailing weak local winds, influenced by urban heat island. Celje is located in a basin with regular temperature inversions. The height of temperature inversion is varied. To the North and to the West of the basin the inversion is initially a bottom inversion at a height of about 10-20 meters; towards the South and East it reaches 140 m. The volume of air trapped under inversion is small. It has been proved that in winter the warm air above the town rises and is replaced by the cool (polluted) air from the surrounding areas. The meteorological conditions are unfavourable and contribute to the build up of pollution. The average wind speed is below 1 m/s and the average yearly daily temperature is 10.1°C.

Sources of air pollution

The main sources of air pollution are industry and traffic. The largest industrial sources are the production of white titanium based on sulphate procedures (1% of the world production), sulphuric acid production, iron foundries, enamel factory and ceramic industry. In the city centre road traffic is the dominating source of air pollution. In some residential areas, poor oil burning is important too. The local heating plants are using gas. In the past, only poor quality coal was used and represented the most important source of SO_2 and BS. In the last ten years, coal was almost completely replaced by gas. The result is a dramatic decrease in SO_2 and BS emissions. Medium-range transported particles from coal power stations contribute a fraction of the total concentration in the urban background.

The most important vehicle category is diesel vehicles (trucks and buses). There is also dense transit traffic going through part of the town and that contributes a lot to traffic air pollution, more than local traffic.

Exposure data

The pollution indicators are monitored by the Agency for Environment and Institute of Public Health of Celje. Only measurements from urban background stations that are geographically representative of the study area and not directly influenced by local sources of air pollution were selected: one station for PM_{10} and one station for BS.

We used 24-hour average values. The daily mean value of one station is selected only if more than 80% of hourly values are available.

BS Monitoring cites

Location	Type
Bolnica	Urban background

PM 10 Monitoring cites

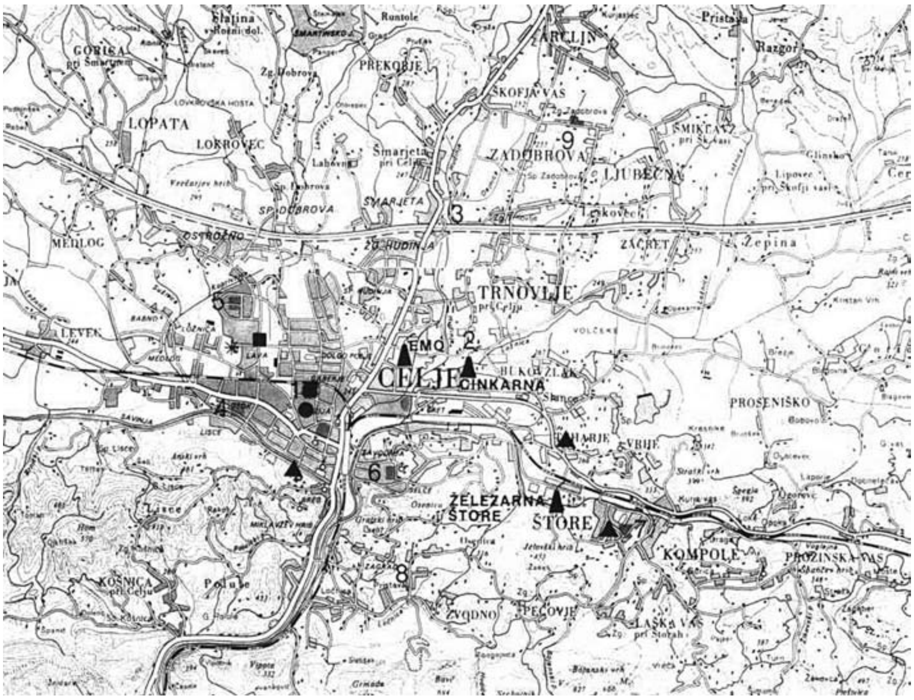
Location	Type
Bolnica	Urban background
IPH	Traffic

For 1999:

- daily mean levels (SD) of **BS** were 15.6 µg/m^3 (14.1)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 4.0 µg/m^3 and 32.0 µg/m^3
- number of days when BS exceeded 20 µg/ m^3 was 76 days
- number of days when BS exceeded 50 µg/ m^3 was 9 days.

- daily mean levels (SD) of **PM_{10}** were 36 µg/ m^3 (19.3)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 14.8 µg/m^3 and 58.7 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 305 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 70 days.

The maximum pollution level of PM_{10} in winter was 127 µg/m^3, and in summer 84 µg/m^3. The maximum pollution level of black smoke in winter was 107 µg/m^3, and in summer 18 µg/m^3.



Air monitoring network map (scale 1: 2 5000).

Meteorological data were provided by Agency for Environment too. The data includes, on a daily basis minimum, mean, maximum temperature and relative humidity from sampling station near primary school Lava at the edge of the town.

Health indicators

National Institute of Public Health provides mortality data coded (ICD 10).

For 1999:

- daily mean for total mortality (ICD9<800): 1.7 and SD (0.35)
- standardised mortality rate using European population as a reference: 913 per 100 000 inhabitants.

Hospital admission data on respiratory and cardiovascular causes also come from National Institute of Public Health, also coded (ICD 10). The admission data are either emergency or routine.

For the year 1999:

- daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) was: 0.7 (0.3)
- daily mean number (and SD) of cardiac hospital admissions all ages (ICD9 410-414, 427, 428) was: 1.06 (0.8)
- ncidence rate of cardiac admissions all ages was: 7.7/1 000
- incidence rates of respiratory admissions all ages was: 15.2/1 000
- incidence rates of respiratory admissions 65+ years was: 36.5/1 000

Data on influenza also come from National Institute of Public Health (ICD 10).

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction of 5 µg/ m^3 in the annual mean value of BS

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	9	0.2	0.1	0.3	0.4	0.2	0.6
20 µg/m^3	76	1.4	0.7	1.9	2.8	1.4	3.8
By 5 µg/m^3	NA*	1.9	1.1	2.6	3.7	2.2	5.2

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	9	0.2	0.1	0.4
20 µg/m^3	76	1.6	0.6	2.6
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	9	0.0	0.0	0.1
20 µg/m^3	76	0.1	0.0	0.9

PM_{10} scenarios

Acute effects

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	70	1.4	0.9	1.8	2.8	1.8	3.6
20 µg/m^3	305	6.7	4.5	9.8	13.4	9.0	19.6
By 5 µg/m^3	NA*	1.9	1.3	2.6	3.8	2.5	5.1

**NA: not applicable*

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	70	0.7	0.3	1.1
20 µg/m^3	305	3.4	1.4	5.5
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	70	0.9	0.6	1.2
20 µg/m^3	305	4.1	2.8	5.9

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	40.4	24.3	57.0	80.8	48.6	113.9
10 µg/m^3	64.3	38.4	91.4	128.7	76.7	182.8
By 5 µg/m^3	12.9	7.8	18.0	25.8	15.7	36.0

Comments

One urban background station for PM_{10} was used to estimate the exposure for Celje in the study and one BS urban background station for BS. The values from these stations represent accurately the real PM_{10} and BS exposure throughout the city.

There are two important air pollution point sources, titanium production plants and iron foundries. The pollution due to the production of titanium has improved in the last five years, new cleaning systems were introduced and further reduction is expected. The sore point is still iron foundries. There are plans to introduce cleaning systems in the next two years.

Small domestic furnaces were an important source of BS and SO_2 in a past. Almost 10 years ago, the clean action plan was introduced with the aim to reduce air pollution.

The levels of BS were much higher, the reduction is mostly due to the introduction of gas in almost all parts of the city. In the last ten years, more than 45 km of gas pipeline network has been built, the price of gas being subsidised by local authorities with bank loans available at low interest rates so that individuals can connect to the gas pipeline network.

With a further reduction of BS levels, we could save a few lives per year and decrease the number of hospital admissions for cardiovascular diseases for a few cases. The main potential for BS reduction is further introduction of gas.

The levels of PM_{10} give much greater concern. The annual daily mean level of PM_{10} is not decreasing and was 36 µg/m^3 in 1999. The main sources of PM_{10} pollution are industry and traffic. The air pollution from traffic is partly due to transit traffic at the edge of the city. Diesel buses constitute the main local public transport and part of the vehicle fleet is not kept in good condition. The ban on traffic in the city centre is already in place, with a large number of pedestrian zones, and further steps have been taken to reduce traffic in the broader area.

At present, no comprehensive action is being taken to reduce traffic PM_{10} pollution. PM_{10} pollution represents a heavy burden for the health of the inhabitants of the city. There are almost 10 deaths and 10 hospital admissions for cardiovascular diseases and respiratory diseases per year that can be attributed only to an excess in the EU level (20 µg/m^3, which will be enforced in 2010). In the long run, more than 70 lives per year could be spared, providing that long-term PM_{10} average annual values do not exceed 10 µg/m^3.

City transport policy cannot only focus on the demand for roads but must make walking, cycling and public transport real and accessible choices. There are attempts to introduce cycling paths. Public health and health promotion is going to play a major role in developing these strategies and in their cross-sectoral implementation through Green Transport Plans, local Transport Plans and by improving access to public transport.

A program is going to be prepared to reduce traffic emissions. The main point is to limit the traffic in the city and offer cheap parking lots outside the city with the aim of detouring the transit traffic out of the edge of the city centre. There are already plans for new traffic flows. The fact is that Celje faces extremely unfavourable meteorological conditions (weak winds, temperature inversion), therefore the only solution is a reduction of emissions.

The data on air quality are displayed in the city centre and are accessible by phone and should be available shortly on the web. During the air pollution peaks, citizens are warned not to go out, and are asked not to use motor vehicles.

It is of vital importance to inform inhabitants of the city on air quality. The problem of air pollution should take a more important place within city problems. The people should be properly informed and authorities should take a more active role in promoting health and environmentally friendly transport such as walking and cycling. The first important measure will be the adoption of a new local transport policy, and more efficient control of certain industrial emission sources.

The Apheis programme should encourage policy-makers to accelerate the process of adopting new measures that will prevent and reduce air pollution in the city. The first important measure should be the adoption of new local transport policy.

Celje partners

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Peter Otorepec- Institute of Public Health of the Republic of Slovenia, coordinator

Andrej Planinšek, Agency for Environment
Andrej Uršič, Institute of Public Health of Celje

CRACOW CITY REPORT

Background

Cracow is the third largest Polish city with about 738 000 inhabitants (13.4% older than 65 years) and is 327 km^2 in size. The city is located in the Vistula river valley and is characterised by frequent inversions of temperature and has a lower wind speed than in other large Polish cities. The mean daily temperature over a year is about 8.3°C and exceeds 20.5°C during 5% of the warmest days in a year. The mean daily relative humidity in a year is about 79% and it is 94% or more during 5% of the most humid days in a year.

Sources of air pollution

Transportation, large smelter factory and individual coal-based heating systems are the main air pollution sources in the Cracow. Dust industry emissions are 6 800 tons per year. Good estimates are lacking in order to attribute air pollutants to particular sources.

Exposure data

The ambient air pollution concentration in Cracow is monitored by the manual measurement network operated by Sanitary-Epidemiological Station. This network has been operating since 1968. Now the network consists of 12 sampling sites of BS and strong acidity as SO_2. There is also a small network of automatic measurements operated by the Environmental Protection Inspectorate; however a number of the stations, their location and monitoring programme have been changing. One of the automatic stations is traffic-oriented and the others measure urban background pollution. All automatic stations measure NO_2 and SO_2, some measure PM_{10}, O_3, CO, metals and meteorological parameters.

Since the second half of 1970s, a decrease in air pollution concentrations has been observed for all pollutants except O_3. The main reason for this decline is a change in heating systems – local sources using coal have been replaced by central power plants, and a decline in the industrial emissions (iron and aluminium smelters). There was no winter smog episode in the second half of 1990s.

For 1999:

- daily mean levels (SD) of **BS** were 36.5 µg/m^3 (40.0)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 10.5 µg/m^3 and 75.0 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 208 days.
- number of days when BS exceeded 50 µg/m^3 was 68 days.

- daily mean levels (SD) of $\mathbf{PM_{10}}$ were 45.4 µg/ m^3 (31.6)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 20.5 µg/m^3 and 79 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 327 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 110 days.

Meteorological data were purchased from the Institute of Meteorology and Water Management in Warsaw.

Health data

Data on all deaths in Poland have been collected by the Central Statistical Office using death certificates completed by physicians. The underlying cause of death was recorded with 3-digit code of ICD-9 until the end of 1996 and 4-digit code of ICD-10 since then. Death records of the permanent residents of Cracow who died in the city or the surrounding region (voivodship) were extracted and processed at the National Institute of Hygiene.

Standardised mortality rate (ICD9<800) using European population in Cracow is 766.5 per 100 000 inhabitants.

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke as, for the time being, there are no exposure-response functions available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 μg/m^3 to 50 μg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 μg/m^3 to 20 μg/m^3 (to take into account countries with low levels of BS)
- for a reduction of 5 μg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m^3, above 20 to 20 μg/m^3 and all days by 5 μg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 μg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 μg/m^3	68	38.4	19.4	50.8	5.2	2.6	6.9
20 μg/m^3	208	83.0	41.8	110.2	11.2	5.7	14.9
By 5 μg/m^3	NA*	19.9	11.7	28.3	2.7	1.6	3.8

**NA: not applicable*

PM_{10} scenarios

Acute effects

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 μg/m^3 to 50 μg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 μg/m^3 to 20 μg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 μg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 2 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	110	50.5	42.5	58.6	6.8	5.8	7.9
20 µg/m³	327	142.8	120.1	165.4	19.3	16.3	22.4
By 5 µg/m³	NA*	20.6	13.6	27.5	2.8	1.8	3.7

**NA: not applicable*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m³, and by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m³	142.6	86.5	199.1	19.3	11.7	27.0
20 µg/m³	643.2	383.9	913.5	87.1	52.0	123.8
10 µg/m³	878.2	519.7	1 258.1	119.0	70.4	170.4
By 5 µg/m³	139.1	84.5	194.2	18.9	11.4	26.3

Comments

The most important step to reduce particulate pollution in Cracow has been the modification of the heating system in the central part of the city and the development of ring highways. The obtained results of HIA will be an important argument to obtain necessary investment resources for reduction of particulate emission in Cracow area.

The Apheis Technical Committee has been established to implement the programme provided that the city authorities will assign the necessary funds. The local programme coordinator has been working for Sanitary Inspection and will receive necessary backup from this institution as well as from the regional Environmental Inspectorate.

Cracow partners

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DUBLIN CITY REPORT

Background

Dublin is the capital and main administrative area for Ireland. It is situated on the east coast of Ireland and is the major population centre in the country. It also has a busy port through which a significant portion of imports/exports for the whole of the country travel.

Dublin has what is described as a temperate climate, with prevailing SW winds. The population of the Greater Dublin area is over 1 million people (13% older than 65 years old), however only the main city area has been considered for this study.

Dublin has a temperate climate, meaning that it is not prone to extremes of hot or cold. Because Ireland is on the Atlantic, it is one of the wettest areas in Europe. It is also quite windy, and thus conditions conducive to pollution formation do not occur too often. With that said, there are occasions of high pressure when cold frosty periods can develop in winter and give rise to elevated pollution levels.

Sources of air pollution

There are no major industries in Dublin making significant contributions to air pollution. Since the introduction of the coal ban in 1990, the biggest source of particulate pollution in the Dublin area can be attributed to road traffic. Dublin does not have a metro system and is highly reliant on road transport, buses and private cars for transport. This coupled with large numbers of goods vehicles travelling to the port are the major contributors to particulate pollution levels.

Exposure data

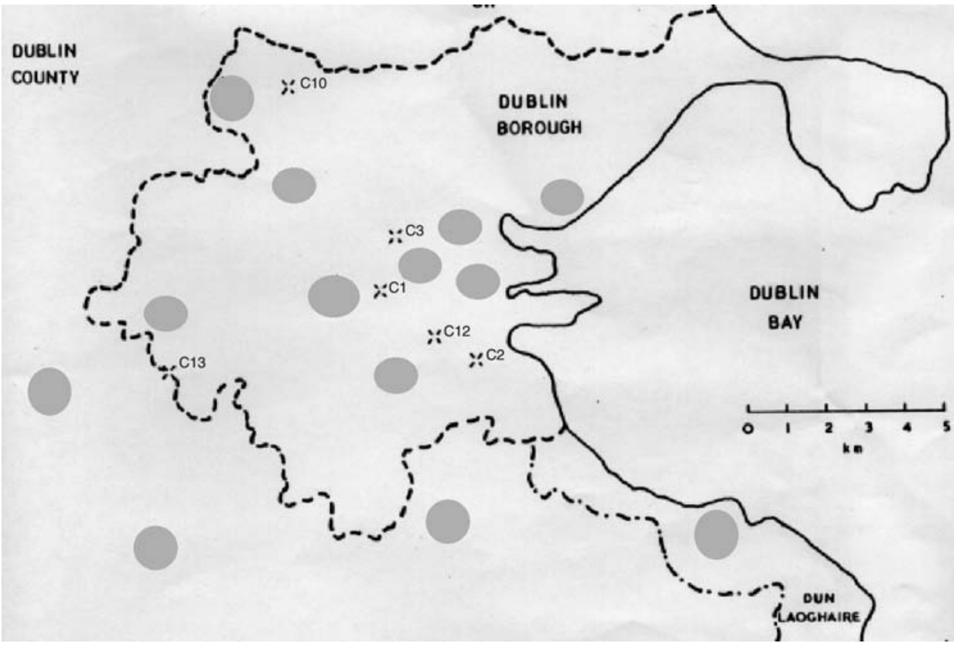
Although air pollution data is available for the year 2000, from a health impact aspect, the most recent data available is 1998. This study is therefore based on the 1998 data. It should be noted that during the 1980's Dublin suffered severe winter pollution episodes.

There are approximately 14 monitoring stations that measure black smoke in the Dublin network, which is operated by the local authority (Dublin Corporation). Six of these stations were chosen for the health impact studies as they had been previously validated for use in the APHEA study. These six monitoring stations can all be described as urban, being located in housing areas.

BS Statistics (all μgm^{-3})		PM_{10}
Mean	11.2	29.9
Max.	43	124
Std Dev.	6.5	

As can be seen from these figures, the BS levels in Dublin are extremely low. A new PM_{10} network is being developed in Dublin; some summary statistics are provided above. The PM_{10} sites (4 in total) are mostly traffic related sites, located close to major traffic arteries, only one site could be described as background. Due to discontinuities in the data it was not possible to use the PM_{10} data for a rigorous HIA study. It is hoped that as the network evolves that it will be possible to include it in future analysis.

The BS values were measured at fixed sites that are part of the Dublin Corporation network. All of the values are for 24hr averages. Daily average values over the six sites were used in the HIA study. See map below.



Monitoring stations: C2= RDS; C3= Mountjoy Sq; C8= Clontarf; C10= Finglas; C12= Herbert St; C13= Bluebell

Symbol of location of other monitoring stations not used in this study

For 1998:

- daily mean levels (SD) of BS were 11.2 µg/m^3 (6.5)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 5.0 µg/m^3 and 19.9 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 34 days.
- number of days when BS exceeded 50 µg/m^3 was 0 days.

Meteorological data is obtained from MET EIREANN at the site at Dublin Airport.

Health data

Mortality data on a daily basis is extracted from data for the whole country, supplied by the Central Statistics Office (CSO). The most recent year for which such data is available is 1998. Mortality for Dublin city (Dublin County Borough) was extracted from the mortality files and sorted by day of death, and by cause of death (according to ICD-9). Only non-accidental deaths were considered.

The standardized mortality rate using the European population (IARC 1982) is 791 per 100 000 inhabitants.

We currently do not have hospital admissions data available to us in a format that would allow us to calculate HIA outcomes. We hope to be able to redress this in the near future, but there are confidentiality aspects to be agreed before we can access the data.

Health impact assessment

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction of 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	0	–	–	–	–	–	–
20 µg/m^3	34	0.8	0.6	1.1	0.2	0.1	0.2
By 5 µg/m^3	NA*	13.5	7.9	19.1	2.6	1.5	3.8

**NA: not applicable*

Comments

Because average pollution levels in Dublin are quite low (11.2 µg/m^3), the effect of reducing levels to 10µg/m^3 does not show any great health benefits. However, the attributable benefit of reducing daily BS levels by 5 µg/m^3 brings a non-negligible decrease in the number of short-term deaths.

By comparison in 1989, max. pollution levels over the same six monitoring stations was 828 µg/m^3, and the yearly average was 46.2 µg/m^3. This massive reduction in pollution levels was achieved by Government intervention, which banned the marketing, sale and distribution of smoky coal in the Dublin area. A paper on the health implications of this intervention is currently being reviewed.

Concerning the PM_{10} data for Dublin, of the four stations, three could be described as traffic, the remaining site could almost be described as rural. There were too many missing days in the data series for PM_{10} to use for the HIA study.

Dublin partners

Pat Goodman* – Luke Clancy “Crest” Saint James`s Hospital – coordinator

* and DIT Dublin

GOTHENBURG CITY REPORT

Background

The study area includes the major part of the population in Gothenburg with some restrictions regarding the most rural areas. Gothenburg is the largest metropolitan area on the west coast of Sweden with a total population of roughly 462 000 (2000), 16.4% older than 65 years. The population density is approximately 1 600 inhab/km^2 when the most rural areas, *i.e.* islands (except Hisingen), are excluded. Some distant parts of this area may have somewhat lower particle concentrations than assumed in this report, but the neighbour municipality Mölndal has its most densely populated area at the southern border of Gothenburg city, so the total number exposed in this area should not be overestimated in these calculations.

Between 1997 and 1999, the yearly mean temperature in Gothenburg was 8.7°C with a maximum monthly average of 18.7°C and minimum monthly average of – 0.2°C. The yearly number of days with rain was 134, and the yearly mean precipitation was 1 084.3 mm.

The concentration of air pollution in Gothenburg is almost equal to the concentration in the much larger city of Stockholm but lower compared with other major European cities. The topography of Gothenburg with long valleys along Göta älv (a river valley), Mölndalsån and other watercourses makes the area sensitive to inversions.

During the past 30 years, there has been a marked improvement of the air in Gothenburg. In the past decades, the major source of pollution was sulphur dioxide generated by various kinds of combustion; but also black smoke (BS), nitrogen dioxide and volatile organic compounds (VOC) were emitted in considerable amounts. In 1980, the yearly amount of emitted sulphur dioxide in Gothenburg was estimated at 15 000 tons, while the same figure in 2000 is estimated at 2 000 tons. The main reason for this dramatic decrease is several successful direct or indirect strategies for reducing air pollution. The development of district heating in combination with regulations on sulphur levels in heavy oils was an important factor in reducing the levels of emitted SO_2. Also, the escalating prices of oil lead to the development of several energy-saving strategies, that lowered the overall consumption of energy. In 1989, the Swedish government set limits on emissions from private vehicles that in practice could not be fulfilled without catalytic engines, and in 1992/1993 limitations were set also for heavier vehicles. In 1996, an environmental zone was created in the central parts of the city. This zone stops traffic with trucks and buses that do not meet predetermined criteria for age (maximum 8 years), weight and exhaust emissions. The result has been lowered emissions of particles and nitrogen dioxide, but also decreasing levels of noise.

Sources of air pollution

Particle pollution in Gothenburg comes from a large number of local sources, but also from other parts, transported from Europe. More than half of the particle concentration (black smoke) has been reported to be a regional background. Approximately 3/4 of the local particle emissions in Gothenburg are from transportation sources including ferries and ships.

At a street level, in very busy streets, pollution from traffic can be severe, with high levels of nitrogen oxides, particles and benzene.

Exposure data

In Gothenburg, there are two stationary urban background monitoring stations in the city centre, Femman/Nordstan (1) and Järntorget (2), two street stations, Gårda (3) and Haga (4) and three mobile measuring stations. A complete description of current instrumentation and details on the measurement sites is given at: http://www.miljo.goteborg.se/luftnet/index-eng.htm.

In this Apheis health impact assessment, PM_{10} data for Gothenburg is from the roof top station at the building Femman in Nordstan (station 1). The measurements are performed with a TEOM instrument, which delivers 1-hour averages of both PM_{10} and $PM_{2.5}$.

Particles are also measured at street level with the mobile measuring stations, but these results were not used for the HIA calculations. Other pollutants such as NO, NO_x, NO_2, O_3, SO_2 and CO are continuously measured at the roof stations and at most of the mobile stations. PM_{10} is correlated to regional sulphate (r= 0.53), black smoke (only measured October – March, r= 0.51) and NO_2 at the same site (r= 0.37).

A map with monitoring stations is given below.

For the year 2000:
- daily mean urban background levels (SD) of PM_{10} were 14.0 µg/m^3 (7.0)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 6.8 µg/m^3 and 22.3 µg/m^3
- the number of days when PM_{10} exceeded 20 µg/m^3 was 45
- there were no days when PM_{10} exceeded 50 µg/m^3.

There are four metrological stations placed in the Gothenburg area, which report hourly a number of parameters.

The distance between station 1 and station 2 is 1 450 meters.

Health data

The Centre for Epidemiology (EpC) is a part of the Swedish National Board of Health and Welfare (http://www.sos.se/epc/epceng.htm.), and is responsible for national health registers used in Apheis, the Cause of Death Registry and the Hospital Discharge Registry.

Statistics Sweden is however entrusted by the EpC with the actual compilation of the mortality statistics. Only 0.8% of cases are lacking a cause of death. Information to the Hospital Discharge Registry is delivered once a year to EpC from each of the 26 county councils in Sweden. The completeness of more than 99% and a low frequency of missing cause (1%) give the register a high quality. However, the delay in national data processing means that baseline data used here are for 1999.

The standardised mortality rate of Gothenburg using the European populationas a reference (IARC 1982) is 600 per 100 000 inhabitants.

The number of acute respiratory hospital admissions 65 years + (ICD9 460-519) is estimated at 2 789 per 100 000 persons aged 65+.

The number of acute cardiac hospital admissions all ages (ICD9 410-414, 427, 428) is estimated at 999 per 100 000 persons all ages.

The hospital admissions rates are based on data from Stockholm.

Health impact assessment

Acute effects

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	0	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	45	3.3	2.2	4.4	0.7	0.5	0.9
By 5 µg/m^3	NA*	14.7	9.8	19.7	3.2	2.1	4.3

NA: not applicable

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 μg/m³ and above 20 to 20 μg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 μg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 μg/m³	0	0.0	0.0	0.0
20 μg/m³	45	2.6	1.0	4.2
Hospital admissions for respiratory diseases (65+)				
50 μg/m³	0	0.0	0.0	0.0
20 μg/m³	45	2.2	1.4	3.1

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 μg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 μg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 μg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 μg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 μg/m³, and by 5 μg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 μg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 μg/m³	0.0	0.0	0.0	0.0	0.0	0.0
10 μg/m³	80.4	48.9	112.1	17.4	10.6	24.2
By 5 μg/m³	99.6	60.5	139.1	21.5	13.1	30.1

Comments

Only one urban background monitoring station for PM_{10} is used to estimate the exposure for Gothenburg in this study. The same station has been used in the epidemiological time series analyses, in which daily numbers of respiratory admissions were associated with PM_{10}. Since there are no important point sources, the above roof level is not expected to vary much across the city.

During the past 30 years, there has been a marked improvement in the air in Gothenburg. The quantities of particles (black smoke), sulphur dioxide, carbon monoxide and lead have declined sharply, as a result of district heating, fewer industry emissions and cleaner vehicles. With today's already low PM_{10} levels some scenarios are not applicable. However, a reduction of annual PM_{10} levels by 5 μg/m³ would lead to a decrease in the number of short and long-term deaths in Gothenburg. Developments indicate that we can expect further reduction in emissions in the future, especially as a result of cleaner vehicles.

Gothenburg partners

Bertil Forsberg – Umeå University – coordinator

Lars Modig – Umeå University

Bo Segerstedt – Umeå University

City of Stockholm environment administration – Christer Johansson

Swedish Environment Protection Agency – Carl-Elis Boström, Tula Ekengren, Britta Hedlund National Institute of Public Health – Eva Falck

National Board of Health and Welfare – Marie Becker

IVL Swedish Environmental Reseach Institute – Karin Sjöberg

NGOs: The Swedish Society for Nature Conservation, The Swedish Astma & Allergy Association

We are also grateful to Curt-Lennart Spetz and Leif Forsberg at The Centre for Epidemiology, Swedish National Board of Health and Welfare, for help with the health register data.

LE HAVRE CITY REPORT

Background

The metropolitan area of Le Havre is 199 km^2 size with a population of approximately 254 585 inhabitants, 15% older than 65 years (1999). It is on the right bank of the Seine estuary, 90 km from Rouen and 220 km from Paris. Geographically, Le Havre has a strategic position as it faces one of the busiest waterways in the world, the English Channel. It has an oceanic climate with minimum and maximum temperatures of 7.9 to 13.2°C, respectively.

Sources of air pollution

38.4% of SO_2 regional emissions (23.1% for NO_x) come from Le Havre metropolitan area. The industries are responsible for 90% of these emissions. (Source : CITEPA 1994).

Exposure data

The air pollution indicators are monitored by the Le Havre air pollution network (AIR NORMAND). Black smoke (BS) concentrations were measured by reflectometry. The BS exposure indicator was constructed by using the arithmetic mean of daily concentrations recorded by 6 selected stations. Weather, temperature and relative humidity data were obtained from METEO FRANCE.

For 1998:

- daily mean levels (SD) of BS were 9.3 µg/m^3 (9.2)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 2.8 µg/m^3 and 20.5 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 39 days
- number of days when BS exceeded 50 µg/m^3 was 3 days.

Health data

Mortality data was provided by the INSERM (National Institute of Health and Medical Research).

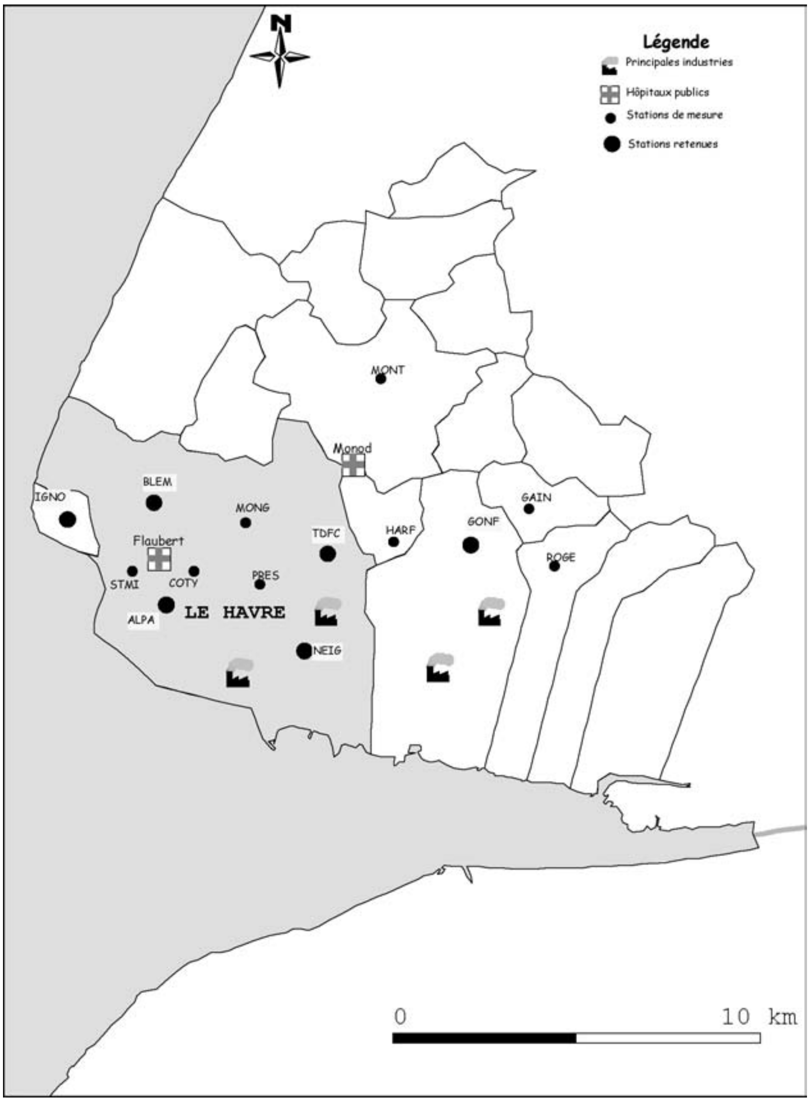
The age-standardised mortality rate using European population for reference was 578 per 100 000 inhabitants.

Hospital admissions data was provided by public hospital of Le Havre metropolitan area. The daily numbers of respiratory hospital admissions (ICD9 [460 – 519]; ICD10 [J00-J99]) among the 65 years old and over were taken from the hospital information system “Programme de Médicalisation des Systèmes d’Information – PMSI”.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998: 0.8 (0.9). The corresponding incidence rate was: 2.1, that is 759.6 per 100 000 per year.

No data available for cardiac admissions all ages (ICD9 410-414,427,428).

Air pollution monitoring sites are given below.



Source IGN - AIR NORMAND 1998

Health impact assessment

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, there are no exposure-response functions available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction of 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m³, above 20 to 20 μg/m³ and all days by 5 μg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 μg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 μg/m³	3	–	–	–	–	–	–
20 μg/m³	39	1.5	0.8	2.1	0.6	0.3	0.8
By 5 μg/m³	NA*	5.9	3.4	8.3	2.3	1.4	3.3

NA: not applicable

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m³ and above 20 to 20 μg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 μg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 μg/m³	na	na	na	na
20 μg/m³	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 μg/m³	3	–	–	–
20 μg/m³	39	0.0	0.0	0.3

na: not available

Comments

Since the most complete mortality and hospital admissions data available was for 1998, the health impact assessment was carried out over this year. With regard to BS, data from 1998 were also used.

The BS exposure indicator was constructed by calculating the arithmetic mean of daily concentrations recorded by 4 ambient stations and 2 industrial stations selected in the city of Le Havre. However, the descriptive analysis of these data shows that the concentrations recorded by these stations were correlated (correlation ≥ 0.70) and have close mean levels of pollution.

With the current BS levels in Le Havre, some scenarios are not applicable. However, a reduction of BS levels by 5 μg/m³ would lead to a decrease in the number of short-term deaths.

The French regulations to monitor air pollution and its health effects and the steps planned to reduce air pollution levels are described in the section on Bordeaux chapter and concern all the cities involved in the PSAS-9 programme.

In addition to the reinforcement of the monitoring by the automated air pollution network (Air Normand), the application of the Regional Plan for Air Quality (PRQA) in Haute Normandie will lead to the development of 3 types of plans:
- A Regional Plan for Air Quality aiming at defining the main trends of the regional policy in dialogue with all the local actors (government representatives, territorial and local communities, associations, etc.)
- Plans for Protection of the Atmosphere (PPA) for cities with over 250 000 inhabitants to reduce, by concrete steps, air pollution to a level lower than the European limit values
- Plans for Urban Transportation (PDU) for cities with over 100 000 inhabitants to organise transport, traffic and parking to minimise their impact on the air quality.

The DRIRE (regional office of Industry, Research and Infrastructure) is in charge of leading, under the authority of the Prefect, the preparation of the PRQA and the PPA.

Le Havre partners

Abdelkrim Zeghnoun, InVS – coordinator

P. Beaudeau, Laboratoire d'Etude et d'Analyse – Le Havre,
E. Briquet, DIM CH du Havre,
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S. Lechangeur, DIM CH du Havre,
B. Marshall, DIM CH du Havre.

LILLE CITY REPORT

Background

In the North of France, the metropolitan area of Lille, called CUDL (Communauté Urbaine de Lille), has a population of slightly more than 1 million inhabitants. 612 km^2 in size, Lille has 86 municipalities but the central activity is mainly around four major municipalities: Lille, Roubaix, Tourcoing and Villeneuve d'Ascq. Its population is relatively young compared to other French cities, with only 12.8% of people aged 65 years +.

The study area of Lille is flat, widely swept by prevailing winds from the West. It has a moderate climate, under the influence of the sea, with a relatively wide range of temperatures. With moderate rains, foggy or cloudy, Lille has little sunshine (generally, 1 900 hours of sunshine per year). Daily mean minimum and maximum temperatures are respectively 7.0 °C and 14.4 °C. Minimum relative humidity is 60.3%.

Situated in the heart of Europe, the traffic in the metropolitan area of Lille is very heavy due to the intersecting of national and international traffic on motorways (A1, A22, A23, A25), and regional and local traffic.

Sources of air pollution

In 1994, in the urban community of Lille, the main source of air pollution emissions was traffic: 73% of NOx emissions, 66% of CO emissions and 42% of non-methane volatile organic compound emissions. Yet, industries continue to play a major role in pollution with 53% of SO_2 emissions *(Source: CITEPA 1994 data).* As for particles, dust emissions came mainly from three plants that incinerate household refuse in the metropolitan area of Lille. Yet they were shut down as they did not conform to the law, and transport is now the main source of particle emissions.

Exposure data

Air pollution data was provided by the AREMA Lille-Métropole air-quality network. This network has 18 monitoring stations representing 43 analysers. Nine air pollution indicators are measured continuously, together with metals (3 analysers) and radioactivity (2 analysers). Since 1997, the network no longer measures BS. The Ecole des Mines' manual air quality surveillance network in Douai provided this data. It runs three monitoring stations on the urban community of Lille (including two urban stations) that measure black smoke (BS) and strong acidity levels.

A map of Lille's air pollution monitoring sites is given below.

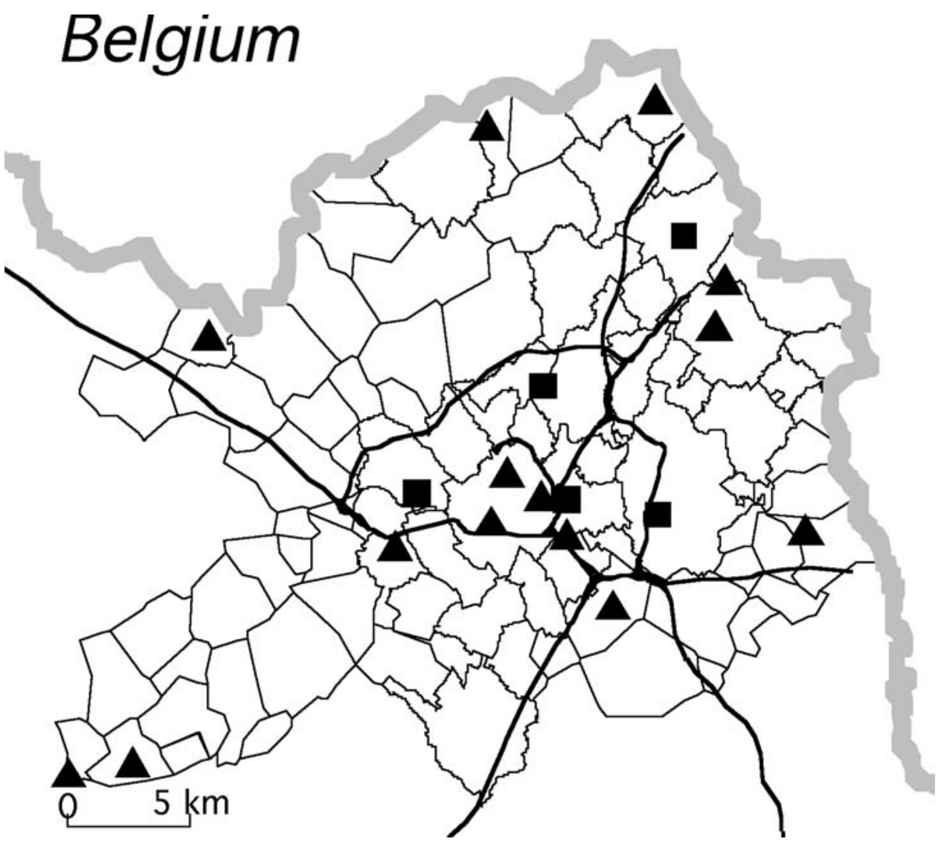
The PM_{10} indicator was built from daily measurements recorded at the five urban stations in 2000. For that year, these 5 stations are very well correlated and have a maximum of 3% of missing values in the series of daily values. When one or more daily data was missing, the method of seasonal means was used instead. The BS indicator was built from data provided by the two urban stations of the Ecole des Mines for 1999.

For 1999:
- daily mean levels (SD) of BS were 8.1 µg/m^3 (6.8)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 2.0 µg/m^3 and 18.0 µg/m^3
- number of days where BS exceeded 20 µg/m^3 was 29 days
- number of days where BS exceeded 50 µg/m^3 was 0 days.

For 2000:

- daily mean levels (SD) of PM_{10} were 19.5 µg/m^3 (7.9)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 11.0 µg/m^3 and 30.0 µg/m^3
- number of days where PM_{10} exceeded 20 µg/m^3 was 147 days
- number of days where PM_{10} exceeded 50 µg/m^3 was 2 days.

Figure 1. **Air quality network, Lille area (■ PM_{10} urban stations used for HIA; ▲ Other monitoring stations ; ▬ Motorways)**



Meteorological data have been provided by Météo-France for all the PSAS-9 cities.

Health data

The information department specialised in mortality data (SC8) at the National Health and Medical Research Institute (INSERM) provides medical causes of death based on the international classification of diseases (ICD9). The daily number of deaths for each city corresponds to the total non accidental or unknown mortality: codes ICD9 < 800. The selection was made according to the main causes of death.

Age-standardised mortality rate for Lille using European population was 648 per 100 000 inhabitants.

Data on hospitalisation for respiratory and cardiovascular diseases are provided by the Medical Information Department or DIM (Département d'Information Médicale) of each of the 5 medical care centres and of the 4 hospitals that provide health care to the inhabitants of the studied urban area. From the Hospital information system, Programme de médicalisation des systèmes d'information (PMSI), the daily numbers of admissions for respiratory diseases (ICD9 [460 – 519]; CIM10[J00-J99]) were taken for patients aged 65 years +.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 was 8.5 (4.0). The corresponding incidence rate was: 6.1, that is to say 2 218.1 per 100 000 per year.

No data was available for cardiac admissions all ages (ICD9 410-414, 427, 428).

Health impact assessment

Black Smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction of 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	0	–	–	–	–	–	–
20 µg/m^3	29	2.6	1.3	3.5	0.2	0.1	0.3
By 5 µg/m^3	NA*	23.9	13.9	33.8	2.2	1.3	3.1

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	0	na*	na	na
20 µg/m^3	29	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	0	–	–	–
20 µg/m^3	29	0.2	0.0	1.5

**na: not available*

PM_{10} scenarios

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the 24-hour daily values of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	2	0.1	0.1	0.2	0.0	0.0	0.0
20 µg/m^3	147	16.6	11.1	22.1	1.5	1.0	2.0
By 5 µg/m^3	NA*	24.6	16.3	32.9	2.3	1.5	3.0

NA: not applicable

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	2	na*	na	na
20 µg/m^3	147	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	2	0.1	0.1	0.1
20 µg/m^3	147	9.6	6.4	13.8

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m³, and by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m³	0.0	0.0	0.0	0.0	0.0	0.0
10 µg/m³	313.8	189.8	439.7	28.7	17.4	40.3
By 5 µg/m³	166.5	101.1	232.5	15.3	9.3	21.3

Comments

In Lille, the PM_{10} data was measured in 2000 when the air quality monitoring network put into place 5 urban stations to measure PM_{10} levels in the entire study zone. In order to obtain more recent data, we chose to use the annual mortality data provided by INSERM for 1998 and hospital admissions data for the same year. The population data were taken from the 1999 population census.

In 2000, there are only two days with PM_{10} higher than 50 µg/m³. In the metropolitan area of Lille, annual mean concentrations of PM_{10} have continued to decrease, from 31 µg/m³ in 1996 to 19.5 µg/m³ in 2000. However, our HIA shows that even a small reduction of 5 µg/m³ in the levels of particulate pollution leads to a considerable benefit in terms of the number of avoidable deaths.

The French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels, are described in the Bordeaux report and concern all the cities involved in the PSAS-9 programme.

The Nord-Pas-de-Calais PRQA (regional plan on air quality) was approved in April 2001. The PPA (plan for protection of the atmosphere) of the metropolitan area of Lille is in progress, and the PDU (plan for urban transportation) has already been adopted. The PRQA plans to conduct some studies to locally assess the health impact of air pollution. In the region, 7 metropolitan areas of more than 100 000 inhabitants, covered by one of the 4 air quality monitoring networks, are included in this decision. The HIA method developed by the InVS should be used.

Lille partners

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LJUBLJANA CITY REPORT

Background

The Ljubljana metropolitan area has a population of roughly 270 000 inhabitants. There are 40 000 (14.8%) people over 65 years. Its climate is a transition between a continental and an alpine climate, with prevailing weak local winds, influenced by an urban heat island. Ljubljana is located in a basin with regular temperature inversions. The meteorological conditions are extremely unfavourable and contribute dramatically to the air pollution. The average wind speed is below 1 m/s, and the average yearly daily temperature is 10.9°C.

Sources of air pollution

In the city centre, road traffic is the dominating source. In some residential areas coal burning and poor oil burning are very important too. The central heating plants only use coal. In the past, they used only poor quality coal and represented the most important source of SO_2 and BS. In the last ten years, poor quality coal has been substituted by a high quality one and new cleaning systems were introduced. The result is a dramatic decrease in SO_2 and BS emissions. Local heating plants and individual heating systems are still responsible for 30% of PM_{10} and BS emissions.

Medium-range transported particles from coal power stations contribute only to a small fraction of the total concentration in the urban background. Traffic constitutes the main source of air pollution in Ljubljana: 70% of the emissions of PM_{10} and BS. The largest vehicle category is diesel vehicles (city buses). Public transport runs on diesel buses only.

Exposure data

The pollution indicators are monitored by the Agency for Environment. Only the measurements from urban background stations that are geographically representative of the study area and not directly influenced by local sources of air pollution were selected: two stations for PM_{10} and three stations for BS.

PM_{10} monitoring sites

Location	Type
Figovec	Urban background
Agency for Environment	Urban background

BS monitoring sites

Location	Type
Figovec	Urban background
Agency for Environment	Urban background
Moste	Urban background
Vič	Urban background

We used 24-hour average values. The daily mean value of one station is selected only if more than 80% of hourly values are available.

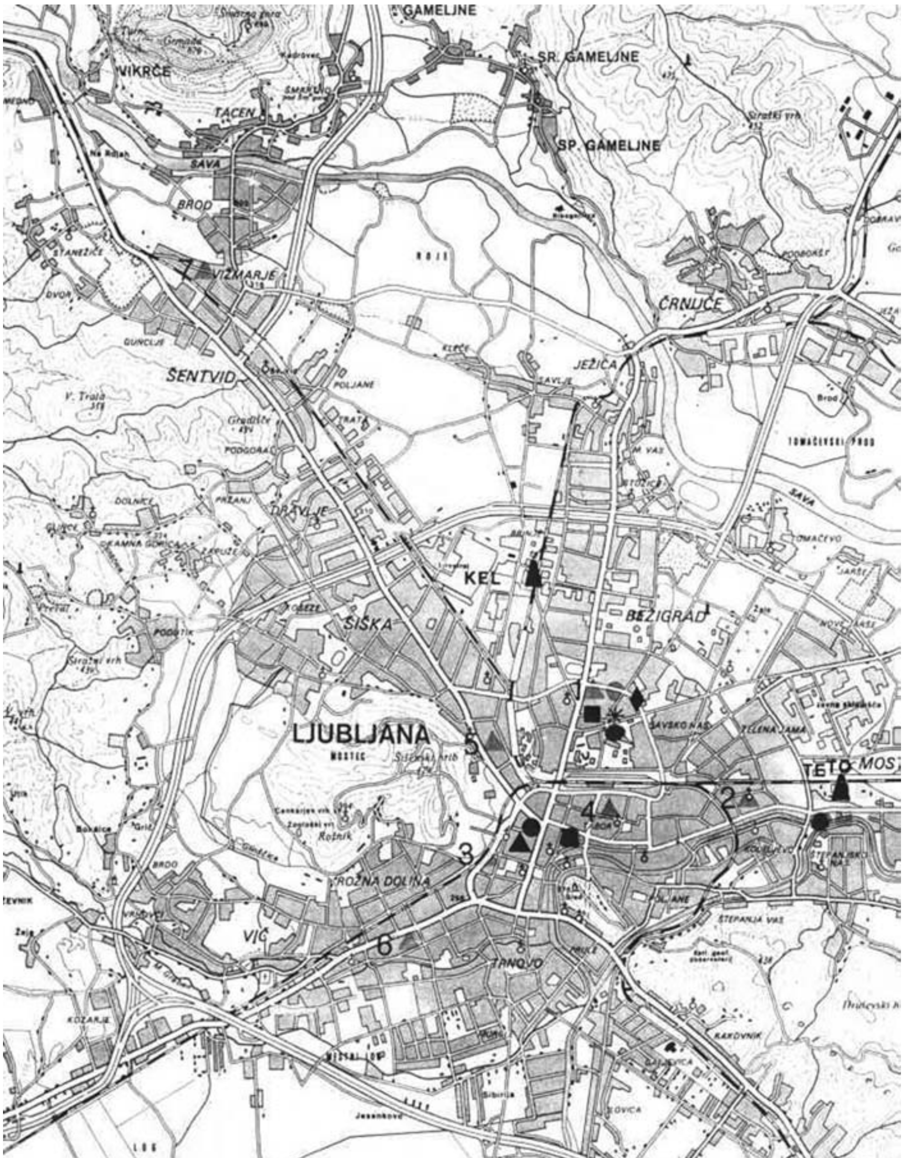
For 1999:

– daily mean levels (SD) of **BS** were 18.3 µg/m³ (15.5)
– the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 6.0 µg/m³ and 36.7 µg/m³
– number of days when BS exceeded 20 µg/m³ was 110 days.
– number of days when BS exceeded 50 µg/m³ was 2 days.

– daily mean levels (SD) of **PM_{10}** were 35.7 µg/m³ (19.5)
– the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 15.7 µg/m³ and 61.7 µg/m³
– number of days when PM_{10} exceeded 20 µg/m³ was 287 days
– number of days when PM_{10} exceeded 50 µg/m³ was 67 days.

The maximum pollution level of PM_{10} is 139 µg/m³ in winter, and 70 µg/m³ in summer. For black smoke, the maximal pollution level is 110 µg/m³ in winter, and 36 µg/m³ in summer.

Air monitoring network map (scale 1: 25000).



Meteorological data were provided by the Agency for Environment too. The data includes, on a daily basis, minimum, mean and maximum temperature and relative humidity from sampling stations in the Agency for Environment yard.

Health indicators

The National Institute of Public Health provides mortality data coded (ICD 10).

For 1999, the daily mean for total mortality (ICD9<800) was 7.7 and SD:1.62.

For 1999, the standardised mortality rate using European population as a reference was 803.5 per 100 000 inhabitants.

Hospital admissions data on respiratory and cardiovascular causes were also provided by the National Institute of Public Health, also coded (ICD 10). The admission data are either emergency or routine.

For 1999:
- the daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) was 2.1 (1.48),
- the daily mean number (and SD) of cardiac hospital admissions all ages (ICD9 410-414, 427, 428) was 5 (2.59).
- the incidence rate of cardiac admissions all ages was 6.6/1 000.
- the incidence rate of respiratory admissions all ages was 9.5/1 000.
- the incidence rate of respiratory admissions 65+ years was 17/1 000.

Data on influenza also come from National Institute of Public Health (ICD 10).

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:
- for a reduction of BS levels on all days above a 24-hour value of 50 $\mu g/m^3$ to 50 $\mu g/m^3$
- for a reduction of BS levels on all days above a 24-hour value of 20 $\mu g/m^3$ to 20 $\mu g/m^3$
- for a reduction by 5 $\mu g/m^3$ in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 $\mu g/m^3$, above 20 to 20 $\mu g/m^3$ and all days by 5 $\mu g/m^3$ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 $\mu g/m^3$	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 $\mu g/m^3$	2	1.6	0.8	2.1	0.6	0.3	0.8
20 $\mu g/m^3$	110	8.6	4.3	11.5	3.2	1.6	4.3
By 5 $\mu g/m^3$	NA*	8.4	4.9	11.9	3.1	1.8	4.4

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m³	2	1.9	0.7	3.0
20 µg/m³	110	10.3	3.7	16.7
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	2	0.1	0.0	0.6
20 µg/m³	110	0.4	0.0	3.5

PM_{10} scenarios

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m³ to 50 µg/m³ (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m³ to 20 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	67	1.4	0.9	1.8	2.0	1.4	2.7
20 µg/m³	287	6.7	4.5	9.8	11.0	7.3	14.6
By 5 µg/m³	NA*	8.7	5.7	11.6	3.2	2.1	4.3

**NA: not applicable*

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m³	67	3.0	1.2	4.7
20 µg/m³	287	16.1	6.5	25.6
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	67	2.2	1.5	3.2
20 µg/m³	287	12.1	8.1	17.3

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	180.1	108.4	253.7	66.7	40.1	93.9
10 µg/m^3	288.5	172.2	409.9	106.8	63.7	151.8
By 5 µg/m^3	58.5	35.5	81.7	21.9	13.3	30.5

Comments

In general, air pollution levels have been decreasing in Slovenia and we expect that this trend will continue. The Slovenian government has been preparing an Air Quality Strategy and it will be endorsed by the end of 2002. The strategy will set out standards and objectives to reduce emissions and improve air quality.

Both urban background stations for PM_{10} were used to estimate the exposure for Ljubljana in the study and three BS urban background stations for BS. The values from the stations correlate very well and represent a real PM_{10} and BS exposure throughout the city. There is no important point source except central heating plants, which were in the past an important source, but significantly lost their importance due to the use of high quality coal and the introduction of a sophisticated cleaning system.

The levels of BS were much higher 10 years ago, this reduction is mostly due to improvements on central heating plants and the use of gas in some parts of the city.

The annual daily mean level of BS has been decreasing for at least 10 years, and decreased for another 20% between 1999 and 2001, and has now probably reached the bottom level (15 µg/m^3).

Nevertheless, with a further reduction in BS levels, the number of deaths could diminish by 9 per year and the number of hospital admissions for cardiovascular diseases could decrease by 10 cases. The main potential for BS reduction is a further introduction of gas and smokeless coal as main fuel sources.

The levels of PM_{10} are of much greater concern. The annual daily mean level of PM_{10} is not decreasing and was 35.7 µg/m^3 in 1999. The main source of PM_{10} pollution is traffic. Buses are the main form of public transport and run on diesel. Diesel buses and trucks are very common, and part of the vehicle fleet is not kept in good condition. The centre of the city is lacking traffic-free zones and pedestrian zones are scarce.

At present no comprehensive action is being taken to reduce traffic PM_{10} pollution. PM_{10} pollution represents a heavy burden on the health of the population living in the city. There are at least 7 short-term deaths and almost 16 hospital admissions for cardiovascular diseases per year that can be attributed to exceeding EU levels that will be enforced in 2010 (20 µg/m^3). In the long run, almost 300 lives per year could be spared, providing that long-term PM_{10} average annual values do not exceed 10 µg/m^3.

As for Celje, the city transport policy cannot only focus on the demand for roads but must make walking, cycling and public transport real and accessible choices. Public Health and Health Promotion is going to play a major role in developing these strategies and in their cross-sector implementation through Green Transport Plans, local Transport Plans and through improving access to public transport.

A program is going to be prepared to reduce traffic emissions. The main point is to limit traffic in the city, introduce more pedestrian zones, and offer cheap parking lots out of the city. Also, diesel buses should be replaced by more modern vehicles or alternatively by electric trams.

The fact is that Ljubljana faces extremely unfavourable meteorological conditions (weak winds, temperature inversion), therefore the only solution is the reduction of emissions.

In the last couple of years, certain measures to reduce PM_{10} pollution have been taken. City authorities encourage citizens to use public transport rather than private cars and the fleet of city buses is being partly replaced with modern vehicles.

It is of vital importance to inform inhabitants of the city about air quality and its impact on public health. The problem of air pollution should have higher visibility among city problems.

The Apheis programme should encourage policy-makers to accelerate the process to adopt new measures that will prevent and reduce air pollution in the city. The first important measure should be the adoption of new local transport policy, more efficient controls of certain emission sources and faster steps towards a wide use of environmental-friendly fuels.

Ljubljana partners

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Peter Otorepec – Institute of Public Health of the Republic of Slovenia

Andrej Planinsěk, Agency for Environment
Dr Marko Notar, The City of Ljubljana

LONDON CITY REPORT

Background

London lies within a roughly circular basin, radius 45 km covering an area of approximately 1600 km^2. It lies at a latitude of 52 degrees North and enjoys a temperate maritime climate. In 1999, the period used for health impact assessment, average daily temperatures in January and July were 6.2°C and 18.2 °C respectively. Rainfall varied from around 112 mm/month to as low as 16 mm/month. It has a population of approximately 7.2 million people of which 12.6% are over the age of 65 years. (Source: The Meteorological Office).

Sources of air pollution

In the 1950s and 60s the main source of air pollution in London was the combustion of coal for domestic heating and industry. High levels of black smoke (BS) and sulphur dioxide (SO_2) combined with cold stagnant weather conditions to produce the notorious London smog episodes. Following government legislation, particle and SO_2 levels decreased dramatically. More recently the predominant source of air pollution in the London metropolitan area has been transportation: 76% of the emissions of nitrogen oxides, 77.4% of PM_{10}, 97% of CO and 62% of the emissions of volatile organic compounds came from traffic sources. This compared with only 22.4% for SO_2 emissions where the majority of emissions came from power generation and industrial and commercial combustion (Source: London Atmospheric Emissions Inventory, London Research Centre 1997).

Exposure data

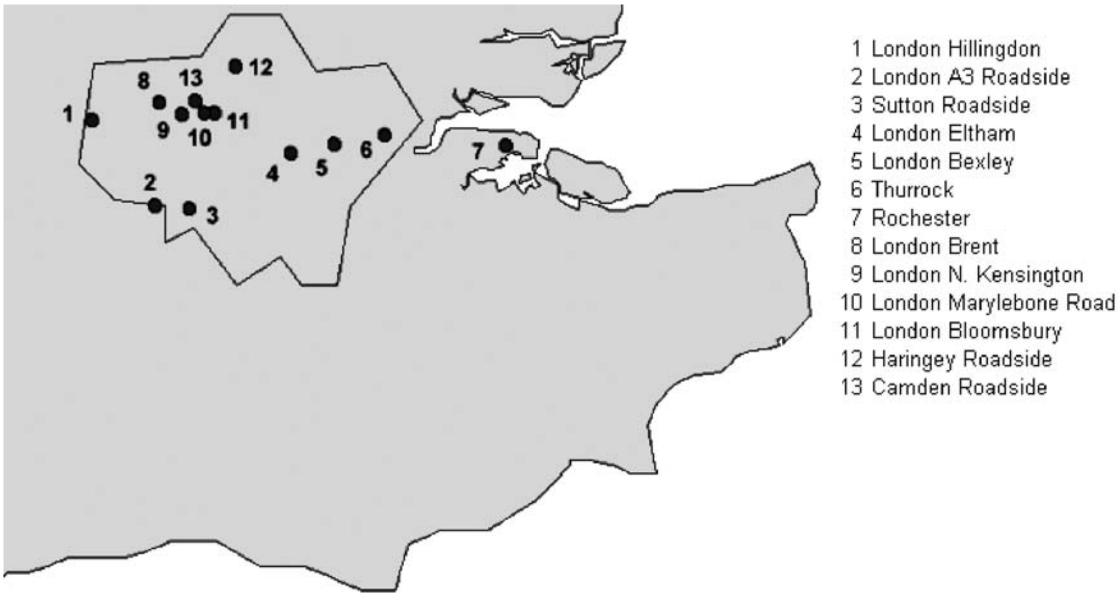
London has a network of 26 automatic air pollution monitoring stations. The pollutants monitored vary from station to station. These stations include urban background, roadside and suburban sites monitoring particles, gases and hydrocarbons. A single central site, classified as urban background, has been used for each of the particle measures (PM_{10} [London Bloomsbury] and black smoke [London City – a central London site that monitors BS and SO_2]). Data from the various monitoring stations are generally highly correlated.

In 1999:

- the daily mean level (SD) of **PM_{10}** was 21.8 µg/m^3 (8.2)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 14.0 µg/m^3 and 32.0 µg/m^3, and there were 180 days when PM_{10} exceeded 20 µg/m^3 and only 4 over 50 µg/m^3

- the daily mean level (SD) of **BS** was 9.5 µg/m^3 (6.0)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 4.0 µg/m^3 and 16.0 µg/m^3, and there were 20 days when BS exceeded 20 µg/m^3 and none over 50 µg/m^3.

A map of the stations monitoring PM_{10} data in greater London is given below.



Scale |———————|
20km

Map of PM_{10} monitoring sites in London

Health data

The Office for National Statistics and Department of Health provide information on mortality and hospital admissions in England and Wales. Annonymised records giving cause of death or admission by ICD 9/10 coding together with age, location of residence and other relevant details can be obtained.

The age-standardised mortality rate for London using a European population for reference was almost 600 per 100 000 inhabitants.

Daily mean numbers of emergency admissions for respiratory and cardiovascular causes were 72 (41) and 106 (19) respectively and baseline incidence rates were 2 872 and 531 per 100 000 respectively. These figures are based upon 1999 data.

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

– for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/ m^3
– for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
– for a reduction by 5 µg/ m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m³, above 20 to 20 μg/m³ and all days by 5 μg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 μg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 μg/m³	0	0.0	0.0	0.0	0.0	0.0	0.0
20 μg/m³	20	16.0	8.0	21.3	0.2	0.1	0.3
By 5 μg/m³	NA*	171.1	99.9	242.4	2.3	1.4	3.3

**NA: not applicable*

Table 2. **Potential benefits of reducing daily BS levels above 50 to 50 μg/m³ and above 20 to 20 μg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of BS.**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 μg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 μg/m³	0	0.0	0.0	0.0
20 μg/m³	20	19.8	7.2	32.4
Hospital admissions for respiratory diseases (+65)				
50 μg/m³	0	0.0	0.0	0.0
20 μg/m³	20	1.2	0.0	11.0

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

PM_{10} scenarios

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

– for a reduction of PM_{10} levels on all days above a 24-hour value of 50 μg/m³ to 50 μg/m³ (2005 and 2010 limit values for PM_{10})
– for a reduction of PM_{10} levels on all days above a 24-hour value of 20 μg/m³ to 20 μg/m³ (to allow for cities with low levels of PM_{10})
– for a reduction by 5 μg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 μg/m³, above 20 to 20 μg/m³ and all days by 5 μg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 μg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 μg/m³	4	2.8	1.9	3.8	0.04	0.03	0.05
20 μg/m³	180	149.4	99.7	199.0	2.05	1.4	2.7
By 5 μg/m³	NA*	176.0	117.0	236.0	2.4	1.6	3.2

**NA: not applicable*

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

	Attributable cases per year			
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiovascular diseases (all ages)				
50 µg/m³	4	1.6	0.6	2.5
20 µg/m³	180	84.1	33.7	134.3
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	4	1.9	1.3	2.8
20 µg/m³	180	102.6	68.5	147.9

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m³, and by 5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
20 µg/m³	432.6	263.4	602.4	5.9	3.6	8.3
10 µg/m³	2777.3	1676.8	3899.4	38.1	23.0	53.5
By 5 µg/m³	1193.7	724.8	1666.5	16.4	9.9	22.9

Comments

The estimated reductions in the numbers of deaths attributable to the chronic effects of air pollution in London are not negligible – a reduction in the annual mean concentration of PM_{10} from 22 to 20 µg/m³ is associated with a reduction of 433 (95% CI: 263-602) in the number of deaths. The number of deaths and emergency hospital admissions attributable to the acute effects of air pollution are however small.

Air pollution levels continue to fall in the UK and it is anticipated that this trend will continue. Vehicle emissions in particular will decrease further as new vehicles and fuels become cleaner, and more polluting older vehicles fall out of the vehicle pool. The UK government published the Air Quality Strategy for England, Scotland, Wales and Northern Ireland in January 2000. This strategy sets out standards and objectives to be achieved for eight key air pollutants between 2003 and 2008. These standards apply to the whole of the UK; no separate standards apply for London. Each local authority, including the many metropolitan authorities within London, has been charged with the task of working towards their achievement in a cost-effective way. A consultation document on proposals for air quality objectives for particles, benzene, carbon monoxide and polycyclic aromatic hydrocarbons was issued in 2001, although this document contains no new national measures.

The newly formed Greater London Authority has issued a Draft Air Quality Strategy for consultation. This is the first publication from the Mayor's office regarding air pollution in London. The strategy encourages the 32 local authorities in London and other bodies to adopt best practices and to undertake cost effective actions to try and reduce air pollution levels so that the Governments objectives are met. In the future therefore, there may be a group in London with which Apheis could work.

London partners

Ross Anderson – Saint Georges's Hospital – coordinator
Richard Atkinson – Saint Georges's Hospital

Potential future partners: Greater London Authority

LYON CITY REPORT

Background

The metropolitan area of Lyon has always kept its vocation of river, railway and road crossroads. It is marked by a rather continental climatic influence, with anticyclonic conditions of temperature inversions in winter. Daily mean temperatures range from 8°C in winter to 17°C in summer. The minimum relative humidity is 52%.

The study area includes 9 municipalities around Lyon with 782 828 inhabitants (15.7% of whom are 65 years +) spread out on 132 km (density of 5 930 inhab./km). With 600 000 cars entering Lyon each day, the study area has heavy traffic. Indeed, this is explained by the fact that the study area employs 405 000 people, 60% of whom do not live in the study area, and 320 000 people living in the study area of whom more than 50% work outside this area.

Sources of air pollution

60% of sulphurated emissions come from industries, for the greater part resulting from the Feyzin refinery (Valley of the Rhone, in the South of the metropolitan area), and occasionally from urban heating systems. 60% of nitrogen and carbon monoxide emissions come from road traffic. There are various kinds of particles, and the finest are linked to road traffic. (Source : CITEPA 1994).

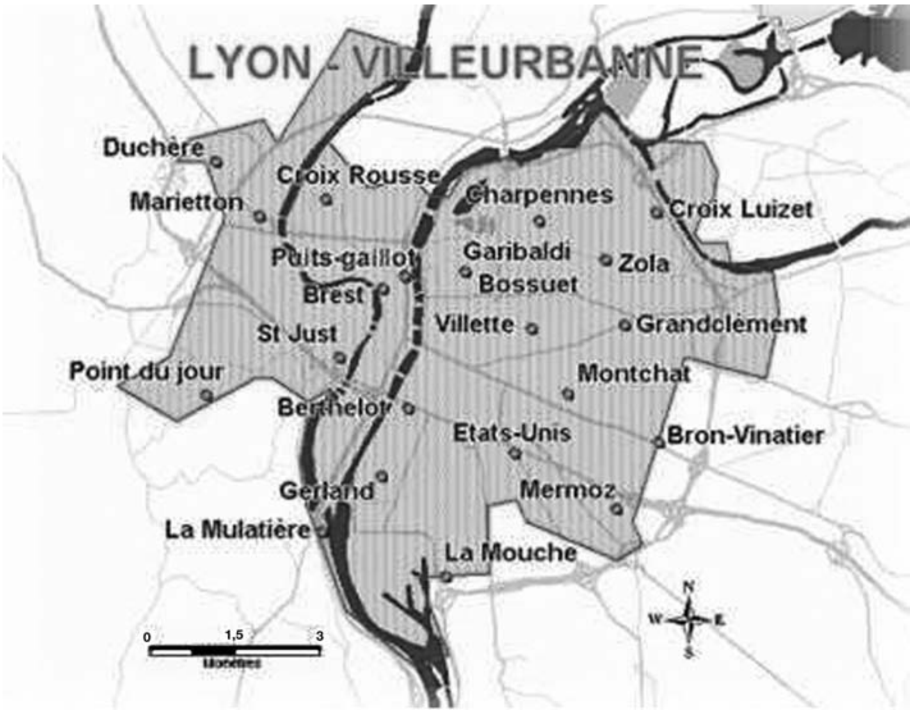
Exposure data

Pollution indicators are monitored by Coparly. The data from Coparly allowed the construction of air pollution indicators used for the programme PSAS-9. Because of the history of Lyon's network (with old monitoring sites orientated to the surveillance of emissions from industries), relatively few urban stations were able to supply series of data that met the criteria for the last few years. Thanks to recent reorganisations, this situation will change.

PM_{10} levels have been measured since 1996 by four analysers of which three are influenced by the traffic; the fourth can be considered as being in an urban site. Since then, more PM_{10} analysers were introduced, together with two $PM_{2.5}$ analysers (one in an urban site) since 2001. Annual mean levels of the one urban monitoring site (Bossuet, see map) have been decreasing progressively since 1996: 29 µg/m^3 in 1996, 32 µg/m^3 in 1997, 27 µg/m^3 in 1998, 23 µg/m^3 in 1999 and 2000.

Even if levels of acid-particulate pollution indicators are decreasing, NO_2 and O_3 levels are constant or even slightly increasing.

The map below shows part of the network in the centre of Lyon.



Source: COPARLY

BS levels were not measured under the most favourable conditions because increased measurements of BS were not considered a priority during the recent reorganisation. Therefore, we did not use BS in Apheis.

The data selected for the HIA are the ones measured in 2000 by the two urban sites, and were not influenced by a local source of pollution. During this period, annual means are 23.6 and 22.5 µg/m^3; the correlation coefficient of the two series is 0.94.

When one or more daily data were missing (i.e. more than 25% of the hourly data missing in a 24 hr period) of one or more sites (2.2% missing data for one, 6.3% for the other), either the seasonal mean method or the linear regression method was used, depending on the duration of the period of missing values.

For 2000:

- daily mean levels (SD) of PM_{10} were 23.0 µg/m^3 (12.0)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 11.8 µg/m^3 and 37.3 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 186 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 14 days.

Meteorological data have been provided by Météo-France for all the PSAS-9 cities.

Health data

Mortality data was collected by the common service of information on the medical causes of death (SC8) of the INSERM. The daily number of deaths for every city corresponds to the total non-accidental mortality: codes CIM9<800. The main cause of death was used for the selection procedure.

The age-standardised mortality rate for Lyon using European population as a reference was 477 per 100 000 inhabitants.

Hospital admissions data were collected by the Department of Medical Information (DIM) at three public hospitals in the studied area (Hospices Civils de Lyon, Clinique E. André, Hôpital Saint Luc). The daily numbers of respiratory hospital admissions (ICD9 [460–519]; ICD10 [J00–J99]) among the 65 years + patients were extracted from the hospital information system (Programme de Médicalisation des Systèmes d'Information, PMSI).

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460–519) for 1998 was 4.8 (3.1). The corresponding incidence rate was 3.9 per 100 000 inhabitants, that is to say 1 423.5 per 100 000 per year.

No data was available for cardiac admissions all ages (ICD9 410–414, 427, 428).

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	14	1.4	1.0	1.9	0.2	0.1	0.2
20 µg/m^3	186	20.2	13.5	26.9	2.6	1.7	3.4
By 5 µg/m^3	NA*	17.1	11.3	22.8	2.2	1.4	2.9

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	14	0.7	0.5	1.0
20 µg/m^3	186	9.6	6.4	13.8

**na: not available*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	72.8	44.6	101.8	9.3	5.7	13.0
10 µg/m^3	298.3	180.1	419.6	38.1	23.0	53.6
By 5 µg/m^3	115.6	70.2	161.3	14.8	9.0	20.6

Comments

Considering the annual mean value of 23 µg/m^3, short-term impact on mortality and hospital admissions together with long-term impact on mortality could show a non-negligible benefit only for scenarios of reduction to 20 µg/m^3 and to 10 µg/m^3.

Data on air pollution and health was not available for exactly the same period. Yet, changes in the forms of exposure-response functions, and of the distribution of health and exposure indicators were insignificant enough from one year to the next, allowing their use in this context.

A complete overhaul of the air quality monitoring network was conducted in 2000 and continues today. It allowed:

- strengthening metrology (quality assurance, level 2 “Cofrac”), expertise (spatial modelling, cartography, temporal modelling, forecast of data, especially provided by fixed and Lidar analysers)
- assessing monitoring sites
- improving communication.

Two $PM_{2.5}$ analysers were put into service at the beginning of 2001.

French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels, are described in the section of Bordeaux and concern all the cities involved in the PSAS-9 programme.

In the Rhône-Alpes region, the air quality policy allowed assessing the regional and local situation, suggested guidelines to reduce emissions, and prepared a list of the regional problems that require further investigation.

Regarding urban traffic, the beginning of 2001 was marked by the construction of two tramway lines, which involved the narrowing of roads used by cars and hence reduced car traffic. As for pollution awareness, for the first time in 2001, Lyon participated in the “No car day” event.

Lyon partners

Philippe Saviuc – InVS- coordinator

F. Bouvier (COPARLY)
C. Callens (DRASS – SSE)
C. Colin (DIM – Hospices Civils de Lyon)
AM. Durand (DDASS Rhône)
B. Fabres (CIREI Rhône-Alpes Auvergne, DRASS Rhône-Alpes)
V. Formysin (DDASS Rhône)
P. Gillet (DIM, Clinique Eugène André, Lyon)
J. Manchon (DIM, Hôpital Saint Joseph, Lyon)
M.C. Ravault (DRASS Rhône-Alpes)
S. Rey (CIREI Rhône-Alpes Auvergne, DRASS Rhône-Alpes)
P. Ritter (Direction Ecologie Urbaine, Ville de Lyon)

MADRID CITY REPORT

Background

The city of Madrid is located on a plateau 600 meters above sea level between the Central mountain system and the Toledo Mountains, in the centre of the Madrid Region. Although its area is only 7.5% of the total area of the region, 57% of the population lives in the city. In 1998, the population was 2 881 506 people, 17.8% older than 65 years.

The annual daily mean for maximum temperatures is 19.1°C, ranging from 9.6ºC in the coldest month to 30.7ºC in July. The annual daily mean for minimum temperatures is 9.5ºC, ranging from 2.7ºC in January to 18.0ºC in July. The annual mean relative humidity is 56%. Rainfall varies from 9 to 64 mm/month.

The winds are relatively frequent allowing the dispersion of pollutants although there are different types of air pollution situations throughout the seasons due to the magnitude of emissions.

During the cold seasons, air pollution episodes occur when there is a persisting anticyclone in the peninsula for a few days, causing a temperature inversion. The temperature inversion results in a concentration of winter pollutants (SO_2 and particles) until the arrival of a new front.

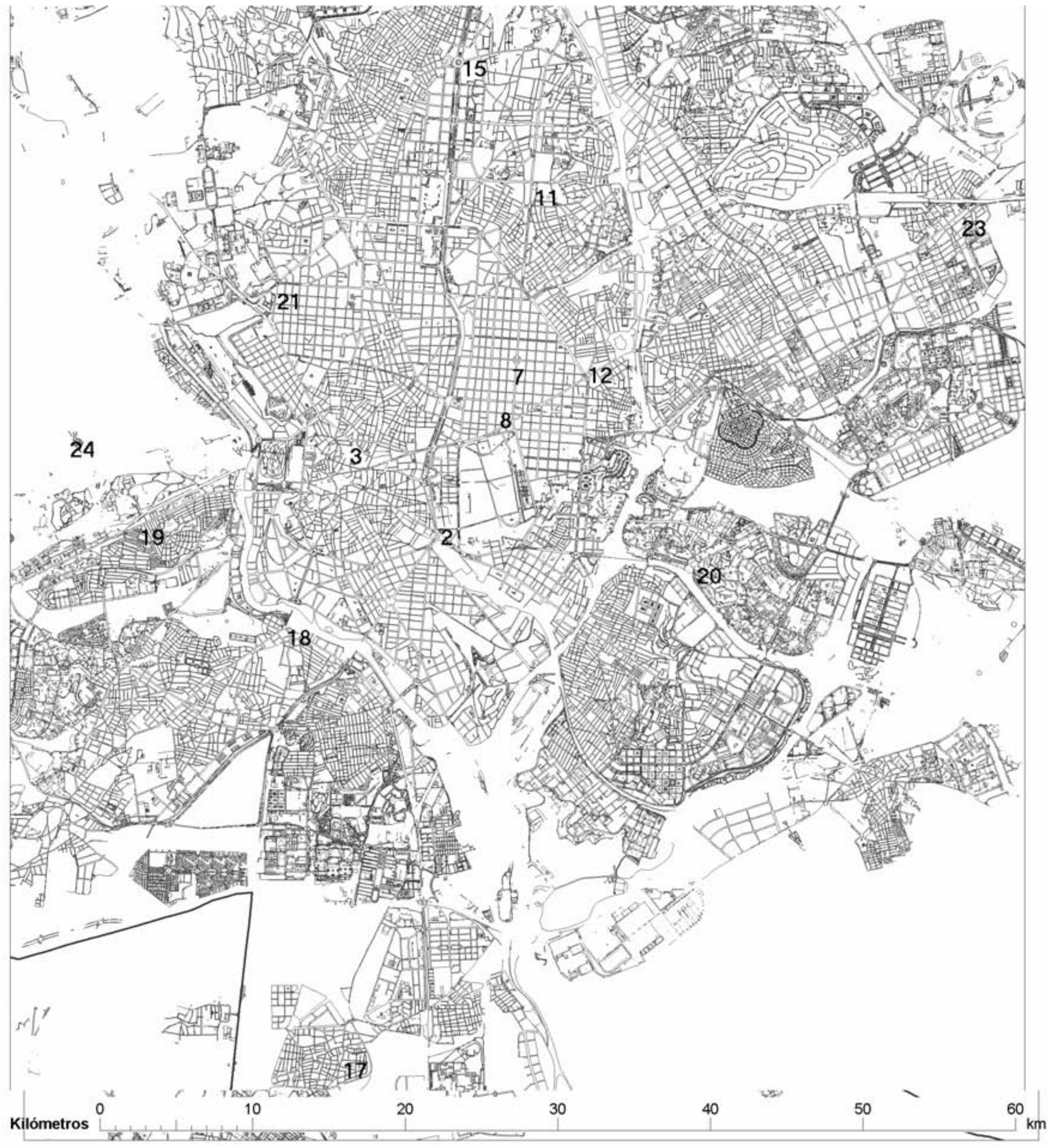
On the contrary, during the hot seasons, the important increase in ground temperatures generates thermal streams that drive air pollutants to greater heights. The increase in the number of hours of sunshine and the maintained emissions of nitrogen oxides due to traffic and other combustion processes, as well as other organic volatile compounds of biogenic and anthropogenic origin, cause a favourable situation for the development of photochemical reactions that produce high levels of photochemical pollution, especially the troposphere ozone (http://medioambiente.comadrid.es/atmosfera/atmosfe.htlm).

Sources of air pollution

The city of Madrid is the centre of a metropolitan area with heavy traffic. There is no heavy industrial activity affecting air quality. There is an important level of emission of air pollutants primarily due to the activity of the population. Transportation constitutes the main source of air pollution, followed by boilers and, to a lesser degree, industry.

Exposure data

The air pollution indicators are monitored by the "Sistema Integral de Vigilancia, Predicción e Información de la Contaminación Atmosférica", which is the air quality network for the city of Madrid managed by the Madrid City Council. The network includes 25 monitoring stations that measure sulphur dioxide, PM_{10}, nitrogen dioxide, carbon monoxide, ozone, benzene, toluene, and also meteorological variables and noise levels (figure below). For HIA, 24h average values of PM_{10} are provided by 14 stations selected according to the criteria of data completeness established by the Apheis guidelines; 12 of them are classified as traffic stations and PM_{10} levels might be overestimated.



For 1998:

- daily mean levels (SD) of PM_{10} were 36.9 µg/m^3 (16.4)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 19.8 µg/ m^3 and 56.1 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 322 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 59 days.

The “Instituto de Metereología”, from the observatory station in the Retiro Park, provides the meteorological data.

Health data

The Mortality Register of the “Instituto de Estadística de la Comunidad de Madrid” provides the mortality data, coded using the International Causes of Diseases, ICD 9. We used the annual revision of the city census for 1998 for the exposed population. In 1998, the daily mean number of deaths was 61.7. The standardised mortality rate for Madrid using the European population as a reference (IARC 1982) is 517 per 100 000 inhabitants.

Hospital admission data on respiratory and cardiovascular diseases come from the "Encuesta de Morbilidad Hospitalaria" (Hospital Morbidity Survey) for the year 1998. The survey is developed annually by the National Statistics Institute in a sample that comprises 25% of hospital admissions at 75% of the hospitals in the region. The admission causes are also coded using the ICD9.

The annual rate of cardiac admissions (ICD 9: 410-414, 427,428) is 427.7 per 100 000, which represents a daily mean number of admissions of 33.7 cases. The rate for respiratory hospital admissions in people older than 64 years (ICD9: 460-519) is 1 997.0 per 100 000, with a daily mean of 28.2 cases.

Health impact assessment

For PM_{10} measurements, we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m³ to 50 µg/m³ (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m³ to 20 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	59	33.7	22.5	44.9	1.2	0.8	1.5
20 µg/m³	322	225.7	151.0	300.0	7.8	5.2	10.4
By 5 µg/m³	NA*	69.3	46.0	92.7	2.4	1.6	3.2

NA: not applicable

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m³	59	15.4	6.2	24.6
20 µg/m³	322	103.1	41.4	164.1
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	59	23.0	15.4	33.2
20 µg/m³	322	153.6	103.1	220.7

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

– for a reduction of the annual mean value of PM_{10} to a level of 40 μg/m³ (2005 limit values for PM_{10})
– for a reduction of the annual mean value of PM_{10} to a level of 20 μg/m³ (2010 limit values for PM_{10})
– for a reduction of the annual mean value of PM_{10} to a level of 10 μg/m³ (to allow for cities with low levels of PM_{10})
– for a reduction of 5 μg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 μg/m³, and by 5 μg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 μg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 μg/m³	1546.8	929.9	2181.0	53.7	32.3	75.7
10 μg/m³	2411.5	1437.6	3429.4	83.7	49.9	119.0
By 5 μg/m³	469.1	284.8	654.9	16.3	9.9	22.7

Comments

The exposure data used for HIA may overestimate the exposure due to the use mainly of traffic monitoring stations. This means that the effects may be slightly overestimated.

During the past 12 years, a great effort has been made to achieve better air quality in Madrid. Beyond the measures applied at the national level, similar to those taken throughout Europe, i.e. economic incentives to promote the replacing of old cars, a progressive change to non-lead petrol, systematic inspection of car emissions, etc. In 1990, the city council started subsidizing the replacement of coal-fired boilers. During this period, 70% of them were changed. Public transport buses are being gradually replaced by buses that use natural gas, and the subway and suburban trains have been greatly expanded.

Nevertheless, according to HIA results, if the actual levels of PM_{10} were reduced and all days with levels above 50 μg/m³ reduced to 50 μg/m³, with other risks staying the same, 34 deaths and 39 hospital admissions for respiratory and cardiac diseases would be avoided. The expected benefits of reduced mortality in the long-term if, according to the European directives for 2010, annual mean levels of PM_{10} are reduced to 20μg/m³ are still greater. More than 1 500 attributable mortality cases could be avoided, which represent 53.7 cases per 100 000 inhabitants.

In 1995, the Dirección General de Salud Pública (Public Health Department) at the Consejeria de Sanidad (Regional Ministry of Health) began to work on the health effects of air pollution in the city of Madrid through its participation in the Spanish Multicentre Research project EMECAM, coordinated by the Instituto Valenciano de Estudios de Salud (Valencian Institute for Health Studies).

The Dirección General de Salud Pública is also involved in other multicentre research projects, APHEA 2, EMECAS, and in research on the relationship between air pollution, pollen and asthma.

In the year 2000, the implementation of a surveillance system of the health effects of air pollution in the city of Madrid was initiated as part of its participation in the Apheis project. The Department of Public Health, in coordination with the institutes responsible for the air quality networks at the local and regional level (City Council of Madrid; Regional Environment Ministry) has implemented the surveillance system. An agreement exists between the politicians in charge of Public Health and Environment in the Regional Government to give legal support to the development of health impact assessment of air pollution in the region, as part of the Apheis project.

Madrid partners

Consejería de Sanidad, Comunidad de Madrid: Mercedes Martínez – coordinator, Pedro Arias, Ana Gandarillas, Laura López, Belén Zorrilla.

Ayuntamiento de Madrid: Salvador Castromil, Francisco Moya.

Consejeria de Medio Ambiente, Comunidad de Madrid: Mª Luisa Lara, Laura Crespo.

MARSEILLE CITY REPORT

Background

With five municipalities, the study area of Marseille is 355 km^2 in size and has 856 165 inhabitants. The population is characterised by its slightly higher percentage of 65-75 year olds (18.7%). The Marseille basin is on the Mediterranean seashore at an altitude of 12 metres. It is surrounded by mountains, some of them reaching 800 metres. Marseille has a Mediterranean climate and is very sunny with an average temperature of 11°C to 20°C.

There are two types of strong prevailing winds in this area, the “mistral” and the south-east wind, together with moderate winds such as the sea breeze and the inland breeze. Prevailing winds allow the dilution of pollutants, whereas the sea breeze brings the pollution inland.

Sources of air pollution

The main source of air pollution in the Marseille area studied is road traffic. Pollution from SO_2 is linked to heating and to a few industries still located in Marseille. The SO_2 levels measured by traffic stations are also linked to road traffic. The BS pollution is linked for a large part to exhaust emissions from diesel vehicles. The main source of PM_{10} is traffic but a part seemed due to natural dust (the south wind brings particles from the Sahara). 53% of NO_x emissions are linked to road transport. (Source : CITEPA 1994)

Exposure data

Pollution indicators have been monitored by the Marseille air-quality network AIRMARAIX since 1982. It monitors air quality for the East of the Bouches du Rhône, the Vaucluse and the Var and has 39 fixed stations in total. The study area of Marseille is covered by 13 stations measuring 7 different pollutants (see table 2).

BS has been measured since 1982. Currently, six traffic stations and two urban stations (St Louis and Ste Marguerite) monitor BS. PM_{10} monitoring sites have been set up progressively since 1998. Currently, PM_{10} is measured by three urban stations (St Louis, Cinq Avenues and Thiers/Noailles) and one traffic station.

Only 24-hour average values of the urban background stations were well correlated, and were used for the HIA. The 24-hour average value is validated only if less than 25% of the hourly values are missing. The exposure indicator for BS is the arithmetic mean of two urban monitoring sites for 1998, and the PM_{10} indicator corresponds to the arithmetic mean of three urban monitoring sites for 2000. When one or several daily data were missing from the stations, the methods of average seasons or of linear regression were used instead depending on how long the data had been missing for.

Meteorological data have been provided by Météo-France from the sampling station at the Marseille-Marignane airport.

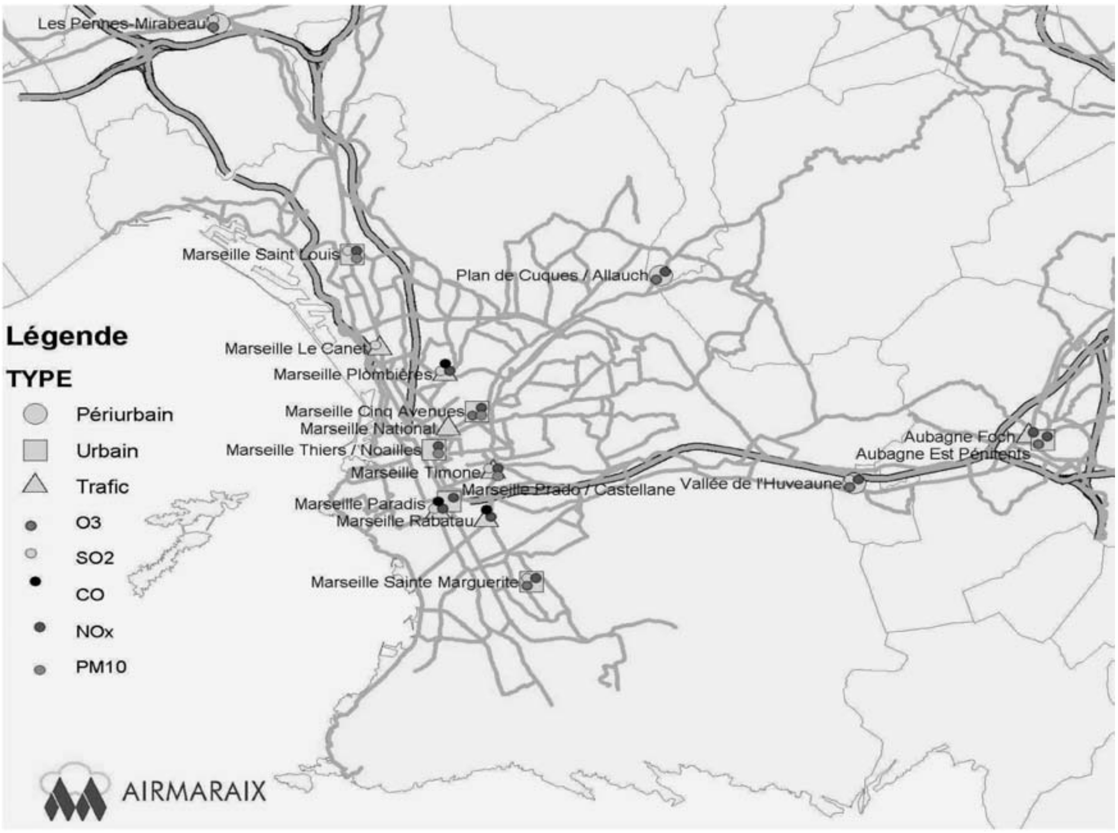
For 1998:

- daily mean levels (SD) of BS were 16.9 µg/m^3 (15.8)
- the levels of BS reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 4 µg/m^3 and 41.6 µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 107 days

– number of days when BS exceeded 50 µg/m^3 was 18 days.

For 2000:

– daily mean levels (SD) of PM_{10} were 24.4 µg/m^3 (9.2)
– the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 13.5 µg/m^3 and 35.5 µg/m^3
– number of days when PM_{10} exceeded 20 µg/m^3 was 243 days
– number of days when PM_{10} exceeded 50 µg/m^3 was 5 days.



Health data

The information department specialised in mortality data (CepiDC) at the National Health and Medical Research Institute (INSERM) provides medical causes of death based on the international classification of diseases (ICD9).

The age-standardised mortality rate using European population as a reference was 525 per 100 000 inhabitants.

Data on hospitalisations for respiratory and cardiovascular diseases are provided by the Medical Information Department, called DIM (Département d'Information Médicale), at each of the 5 hospitals of Public Assistance of Marseille (APM) and of the 4 other public hospitals in the area study. From the hospital information system PMSI (Programme de médicalisation des systèmes d'information), the daily numbers of admissions for respiratory diseases (ICD9 [460-519]; ICD10[J00-J99]) were taken from patients aged 65 years +.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 is 7 (4.1). The corresponding incidence rate was 4.4, that is 1 595.8 per 100 000 per year.

No data is available for cardiac admissions all ages (ICD9 410-414, 427, 428).

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:
- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/ m^3
- for a reduction by 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	18	3.0	1.5	4.0	0.4	0.2	0.5
20 µg/m^3	107	23.0	11.5	30.6	2.7	1.3	3.6
By 5 µg/m^3	NA*	22.8	13.3	32.3	2.7	1.6	3.8

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	18	0.2	0.0	1.5
20 µg/m^3	107	1.3	0.0	11.5

**na: not available*

PM_{10} scenarios

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:
- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

	Attributable cases per year						
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	5	0.6	0.4	0.7	0.07	0.05	0.08
20 µg/m^3	243	30.9	20.7	41.2	3.6	2.4	4.8
By 5 µg/m^3	NA*	23.5	15.6	31.4	2.7	1.8	3.7

NA: not applicable

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

	Attributable cases per year			
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	5	0.3	0.2	0.4
20 µg/m^3	243	15.5	10.4	22.3

NA: not available

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10})

Table 5 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	140.0	85.1	195.4	16.3	9.9	22.8
10 µg/m^3	448.7	270.3	631.4	52.4	31.6	73.7
By 5 µg/m^3	158.9	96.5	221.8	18.6	11.3	25.9

Comments

Mortality and hospital admission data was available until 1998. The indicator for PM_{10} was built in 2000, which corresponded to the first year with all the indicators. After concluding that the levels must have not changed much, the HIA was conducted with the health data for 1998 and the PM_{10} data for 2000.

In Marseille it can be observed that PM_{10} values are already in compliance with the limit values foreseen by the directive for 2005. Considering the annual mean value of PM_{10} (24.4 µg/m^3) and BS (16.9 µg/m^3), the short-term impact on mortality and hospital admissions, together with the long-term impact on mortality, can be quantified only for scenarios for reducing the annual mean to 20 µg/m^3 and to 10 µg/m^3.

History of pollution levels

Since 1983, SO_2 levels have been decreasing thanks to desindustrialisation in the study area and to the limitation of emissions for factories and heating.

For the last ten years, NO_2 levels have remained stable.

As for SO_2 levels, BS levels decreased up to the end of the 1980s but have been increasing since 1990 because of the increase in the number of diesel vehicles (approximately half of the cars).

Ozone levels vary with meteorological conditions but they are high in the summer resulting in higher levels than the accepted standards.

Outlook for the air quality monitoring network

The air quality monitoring network has been measuring new pollutants since 2000-2001. The urban station of St Louis measures 4 heavy metals (cadmium, lead, nickel, arsenic) and 53 VOCs (volatile organic compounds) continuously, including the 40 componants specified in the ozone guideline. The urban monitoring site of Cinq Avenues measures 10 PAHs (polyaromatic hydrocarbons). Finally, two urban $PM_{2.5}$ monitoring sites have been installed under the national program for particles monitoring.

In the future, the three air quality monitoring networks for the PACA region will create a register of regional emissions and will improve expertise on the spatial modelisation of pollution.

The French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels, are described in the section on Bordeaux and concern all the cities involved in the PSAS-9 programme.

The Provence-Alpes-Côte d'Azur PRQA was definitively approved by the Prefect on 11 May 2000. It includes 38 areas, divided in various themes:

– Development of air quality surveillance

– Health and environmental guidelines, information to the public

– Improve and protect the quality of air

– Action against photochemical pollution

– Action against industrial pollution

– Reduction of pollution linked to traffic

– General provisions.

The first step, which is the follow-up and assessment of the PRQA, is in progress.

A number of health impact assessments based on the InVS methodological guide were also conducted (EIS in Aix en Provence and Martigues) or will be conducted (Toulon and Avignon).

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PARIS CITY REPORT

Background

The Paris metropolitan area has a population of roughly 6 million people (13.8% are over 65 years). Paris is the smallest administrative department (105 km^2) in the Ile-de-France region (762 km^2), but is also the most heavily populated (20 169 inhabitants/km^2). The other departments are Hauts-de-Seine with a density of 8 135 inhabitants/km^2, Seine-Saint-Denis (5 855 inhabitants/km^2), and Val-de-Marne, the largest department in the study area (245 km^2 in size but with a density of 5 007 inhabitants/km^2). The climate of Ile-de-France is described as moderate, a transition between the oceanic influences and the continental projections. A moderate climate, however, does not imply a monotonous one. The annual average temperature is 11°C, with a thermal amplitude of 16°C. Cold and hot days are rare and do not last. The spring is usually dry, and little precipitation is observed throughout the year (annual precipitation is 641 mm, with a maximum in autumn and a minimum in February). Northwestern winds are prevailing (Source: Féron 1995).

In 1994, the Regional Observatory of Health, co-funded by the Regional Council of the Ile-de-France region and the national government, created the ERPURS programme for the Paris metropolitan area. It is the first known epidemiological surveillance system on the health effects of air pollution, and it served as a model for the French PSAS-9 programme and for the Apheis programme. ERPURS findings are used by decision-makers at the Ile-de-France regional plan for air quality (PRQA), and monitors air pollution, levels and health impacts.

Sources of air pollution

Transportation constitutes the main source of air pollution in the Paris metropolitan area. Transportation contributes to 66% of the nitrogen oxides emissions, 50% of volatile organic compounds emissions, and 67% of carbon monoxide emissions (Source: CITEPA.1994 data).

Exposure data

The pollution indicators are monitored by the Paris air-quality network (AIRPARIF). Only measurements from urban background monitoring stations that are geographically representative of the study area and are not directly influenced by local sources of air pollution have been selected: two stations for PM_{10} and 10 stations for BS. We used 24-hour average values. The daily mean value of one station is selected only if more than 75% of hourly values are available. Meteorological data have been provided by Météo France from the sampling station in the Montsouris Park (Paris).

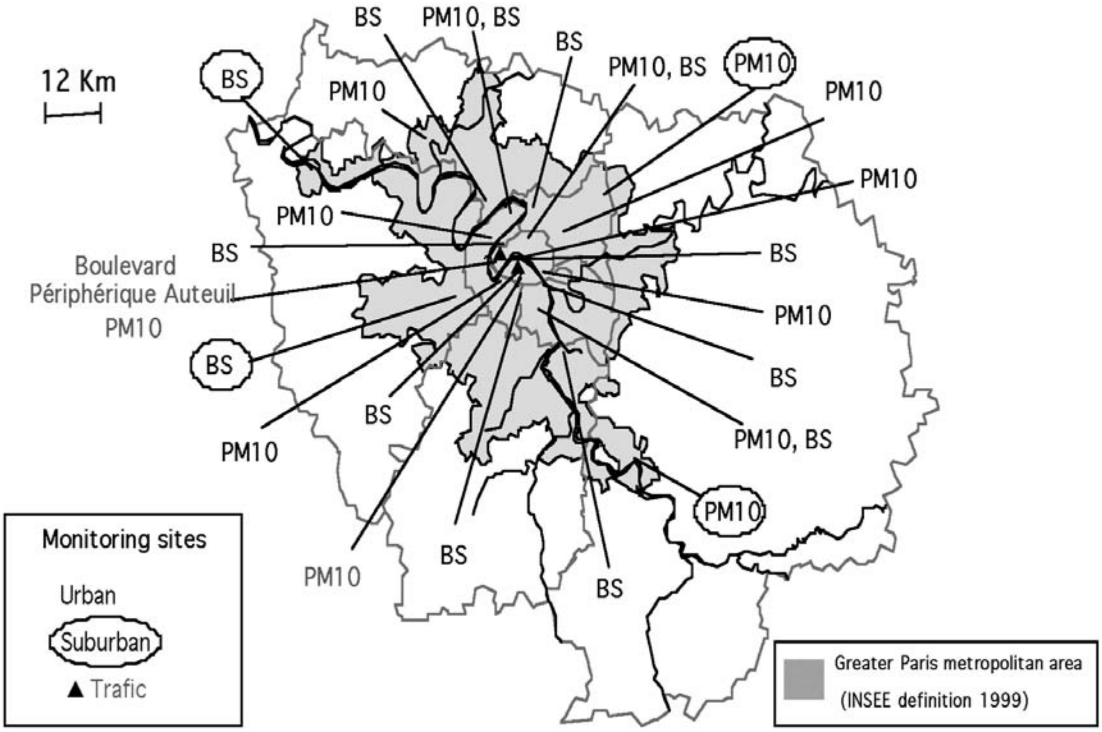
See Paris air pollution monitoring sites below.

For 1998:

- daily mean levels (SD) of **BS** were 19 µg/m^3 (16.8)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 7.4 µg/m^3 and 34.8µg/m^3
- number of days when BS exceeded 20 µg/m^3 was 107 days
- number of days when BS exceeded 50 µg/m^3 was 18 days.

- daily mean levels (SD) of **PM_{10}** were 24 µg/m^3 (13.6)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 12.0 µg/m^3 and 38.9 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 185 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 18 days.

Airparif PM_{10} and black smoke (BS) monitoring sites – February 1st 2002



Health data

The information department specialised in mortality data at the National Health and Medical Research Institute (INSERM) provides medical causes of death based on the international classification of diseases (ICD9).

Age-standardised mortality rate for Paris using the European population as a reference was 470 per 100 000 inhabitants.

Data on hospitalisations for respiratory and cardiovascular diseases are provided by the AP-HP (Paris area hospital network) using the international classification of diseases (ICD9).

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 is 27 (9.35). The corresponding incidence rate was 3.16, that is to say 1 156.9 per 100 000.

No data is available for cardiac admissions all ages (ICD9 410-414,427,428).

Health impact assessment

Black smoke scenarios

We consider only the short-term exposure or acute effects scenarios for black smoke since for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

– for a reduction of BS levels on all days above a 24-hour value of 50 $\mu g/m^3$ to 50 $\mu g/m^3$
– for a reduction of BS levels on all days above a 24-hour value of 20 $\mu g/m^3$ to 20 $\mu g/m^3$
– for a reduction by 5 $\mu g/m^3$ in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	18	35.4	23.5	47.1	0.6	0.4	0.8
20 µg/m³	107	137.0	90.9	183.0	2.2	1.5	3.0
By 5 µg/m³	NA*	126.0	73.6	178.5	2.0	1.2	2.9

NA: not applicable

Table 2. Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m³ and above 20 to 20 µg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m³	na*	na	na	na
20 µg/m³	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m³	18	1.3	0	12.1
20 µg/m³	107	5.2	0	47.1

NA: not applicable

PM_{10} scenarios

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m³ to 50 µg/m³ (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m³ to 20 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for hospital admissions.

Table 3. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m³, above 20 to 20 µg/m³ and all days by 5 µg/m³ – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m³	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m³	18	22.8	15.1	30.4	0.4	0.2	0.5
20 µg/m³	185	177.7	117.9	237.3	2.9	1.9	3.8
By 5 µg/m³	NA*	129.9	86.2	173.7	2.1	1.4	2.8

NA: not applicable

Table 4. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 μg/m³ and above 20 to 20 μg/m³. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 μg/m³	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 μg/m³	na*	na	na	na
20 μg/m³	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 μg/m³	18	7.7	5.1	11.0
20 μg/m³	185	59.8	39.9	86.1

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 μg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 μg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 μg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 μg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 4 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 μg/m³, and by 5 μg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 μg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 μg/m³	721.8	438.6	1007.0	11.7	7.1	16.3
10 μg/m³	2431.0	1464.9	3419.8	39.4	23.8	55.5
By 5 μg/m³	878.9	533.6	1227.0	14.3	8.7	19.9

Comments

The attributable benefit of reducing current daily PM_{10} levels by 5 μg/m³ in Paris is a decrease in the number of short-term deaths by 130 per year and the number of long-term deaths by 879 per year. However, the attributable benefit of only reducing daily PM_{10} above 20 μg/m³ to 20 μg/m³ decreases the number of short-term deaths by 178 per year and the number of long-term deaths by 722 per year - while the benefit of less aggressive action (reduction of daily PM_{10} above 50 μg/m³ to 50 μg/m³) will only reduce the number of short-term deaths by 23 per year. The expected benefits of reducing daily BS are similar to those expected for the reduction of daily PM_{10}.

Attributable benefits for hospital visits are also expected for such daily PM_{10} or BS reduction. For example, reducing daily PM_{10} above 20 to 20 μg/m³ results in a decrease in the number of hospital visits for respiratory diseases among people older than 65 years by 60 per year.

French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels are described in the section on Bordeaux and concern all the cities involved in the PSAS-9 programme.

The improvement policy should focus on reducing mean annual pollution levels, which may have a greater health effect than peak levels. Such a policy is essential within the city of Paris where the highest emission levels are encountered.

In the Ile-de-France region, in 1997-98 particulate matter levels estimated by the BS index were generally lower than the prescribed limit values and approximated the European limit level (DRIRE Ile-de-France 2000). Similarly, the background particulate matter level (PM_{10}) was lower than the newly proposed annual average of 30 µg/m^3. The sole motor vehicle proximity measurement located along the Boulevard Périphérique near the Porte d'Auteuil exit was, however, higher than the newly prescribed limit.

Among the various policies to develop or enforce the tightening of all emission standards for light and heavy transportation, industrial activities, heating or organic solvent use is undoubtedly the most effective. It is expected that tightening emission standards will lead to a major air quality improvement. The enforcement of actual transportation standards between 1994 and 2005 should lead to a decrease of up to 70% in emissions of some pollutants despite a potential major increase in motor vehicle traffic.

A current review of emission sources, especially actual nitrogen oxide sources, demonstrates that our major effort should be directed toward transportation and particularly towards private cars and trucks.

To support environmental protection and the "polluter pays" principle, actions are required as well as the lowering of prescribed standards and the implementation of national or regional tax incentives. It is important to first inform the Ile-de-France inhabitants -from school through daily life- on air quality: its current quality, the mechanisms and origins of polluting activities. Air pollution needs to get its right place within urban issues without underestimating or demonising.

To objectively inform people is the only way to obtain desirable behaviour modifications in transportation or way of life. Motor traffic restraint, thanks in particular to the development of public transportation, should lead to a somewhat larger than expected reduction in traffic emissions. It is necessary to reduce truck transit in central city in order to decrease pollution within this heavily exposed area. These guidelines and their links with the city plan and parking policies will be underlined in the Plan on Urban Transportation.

Finally, it is important to facilitate the distribution and the use of the most recent and environmentally friendly technologies in transportation as well as in housing, and in activities where energy control needs enforcement. Structural measures to decrease the mean age of vehicle fleet and heating-boiler systems are thus recommended.

DRIRE Ile-de-France, Plan Régional de Qualité de l'Air en Ile-de-France, Edition Approuvée Mai 2000. Sartrouville, septembre 2000.

Féron M. Connaître et Comprendre l'Ile-de-France. Région.poche. édition Lec, Hatier. 1995, 112 p.

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ROME CITY REPORT

Background

The metropolitan area of Rome has a population of 2.7 million inhabitants, 17% older than 65 years (1999, municipal registry) and covers an area of 1 495 km^2. The major part of the population (around 80%) lives in the city centre, which has been defined by the local authorities as the area of concern for air pollution control. The city centre (about 320 km^2) includes archaeological and historical sites, business areas, and residential neighbourhoods.

The climate in Rome is typically Mediterranean, with mild winters and hot summers. The annual mean temperature is 15.8°C, and mean annual precipitation is 745.0 mm. Given its location, the climate is influenced by the land-sea interaction, and sea breezes are frequent. The scirocco, a southerly wind, sometimes brings heat waves during the summer.

Sources of air pollution

Air pollution in Rome originates primarily from motor vehicle traffic and home heating devices, while the contribution of industrial plants in the city of Rome is negligible. As a result, concentrations of gaseous pollutants and airborne particles are generally high, but with different seasonal patterns. SO_2 levels are low.

With regard to PM_{10}, more than 60% are estimated to be attributable to traffic and about 30% to home heating devices in the city of Rome.

In recent years, there has been a trend of decreasing levels of all pollutants, except O_3, which was increasing. Between 1993 and 1996, annual mean levels of TPS decreased from 90 µg/m^3 to 72 µg/m^3. Since 1998, PM_{10} has been measured, and the annual mean levels were 45.3 µg/m^3 in 1998 and 43.3 µg/m^3 in 1999.

Exposure data

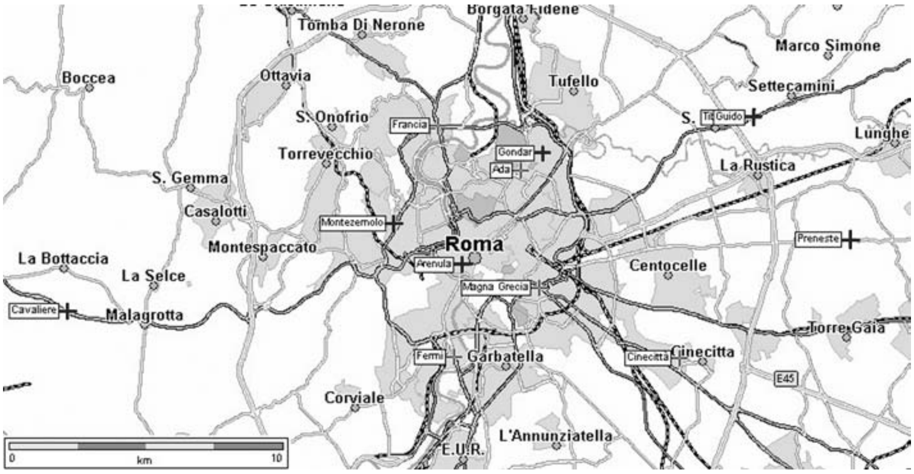
A network of fixed air quality monitoring stations has been operating in Rome since January 1992 under the Regional Department of Environment. From these stations, which are located in densely populated areas within the central city or in parks within the city centre, we selected those meeting the Apheis criteria. Thus, for HIA six stations were considered. From these, four collect data on PM_{10}.

A map of the monitoring stations is given below.

For 1999:

- daily mean levels (SD) of PM_{10} were 43.3 µg/m^3 (17.4)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 25.6 µg/m^3 and 66.6 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 350 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 92 days.

The network of fixed air quality monitoring stations in Rome



boundaries of city centre + monitoring station

Meteorological data were provided by the local weather station in the central area.

Health data

Data on mortality were provided by the Regional Death Registry. Individual information on sex, age, census tract of residence, date of death, place of death, and cause of death are available. The incidence rate was calculated, excluding deaths due to accidents (ICD-9: 800-999), those occurring outside the municipality of Rome, and those with a residence outside Rome.

The age-standardised mortality rate for Rome using the European population as a reference was 525 per 100 000 inhabitants.

The Agency for Public Health of the Lazio Region Health Authority routinely maintains records for all hospital admissions occurring in the region, which encompasses the municipality of Rome, and provides them to the Department of Epidemiology. The information system has been fairly complete since January 1995, covering 96% of both public and private hospitals in Lazio.

Although the system does not permit a straightforward classification of emergency and elective admissions, we tried to remove conditions that were more likely to be unrelated to air pollution and/or elective: day-hospital stay, rehabilitation, surgery, hospital transfers, traumas, deliveries, psychiatric and dermatological conditions, thus excluding about 775 000 admissions (56% of the total). Only primary diagnoses defined as discharges from the hospital were considered.

Daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) (1999) was 23.4 (11.2).

Daily mean number (and SD) of cardiac hospital admissions all ages (ICD9 410-413, 427, 428) (1999) was 52.32 (12.1).

Incidence rate of cardiac admissions was 710.73 per 100 000.

Incidence rate of respiratory admissions (>65 years) was 1851.64 per 100 000.

Health impact assessment

An HIA was performed for 1999 (most recent year available).

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	92	55.2	27.7	73.5	2.05	1.0	2.7
20 µg/m^3	350	293.7	147.9	389.9	10.9	5.5	14.5
By 5 µg/m^3	NA*	66.3	44.0	88.6	2.5	1.6	3.3

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	92	40.9	16.4	65.2
20 µg/m^3	350	217.7	87.7	345.9
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	92	32.8	21.9	47.2
20 µg/m^3	350	173.6	116.5	248.5

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 μg/m³, and by 5 μg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 μg/m³	297.1	180.7	414.2	11.1	6.7	15.4
20 μg/m³	2012.2	1203.2	2852.8	74.9	44.8	106.2
10 μg/m³	2817.1	1670.3	4028.5	104.9	62.2	150.0
By 5 μg/m³	448.6	272.4	626.3	16.7	10.1	23.3

Comments

PM_{10} levels in the city of Rome are still notably above the limits foreseen by the European Union for 2005 and 2010, and the impact on health is considerable even for small reductions in air pollution levels.

Strategies for the control of air pollution launched by the national environmental protection agency include the improvement of the completeness, reliability, and comparability of the data available (e.g. installation of new monitoring stations, modernisation of the existing stations).

In recent years, regulatory measures have been implemented concerning the fixed PM_{10} sources (heating and industrial plants). Thus, the contribution of traffic to the overall pollution has increased. Measures concerning traffic borne pollution focus on the reduction of vehicle emissions, as well as on the improvement of the traffic flow. Concretely, authorities provide initiatives to encourage citizens to use public transport rather than private cars or motorcycles, and the fleet of public vehicles is being renewed in order to reduce pollution produced by public transport.

In periods of extreme air pollution levels, caused by particular meteorological conditions, the municipality of Rome places limitations on private car use. The first step is that private cars that do not have catalytic converters or use diesel fuel are not permitted in the city centre. The second step permits only half of private cars to enter in the city centre, determined by their license plate number (even/odd).

The aims of the Apheis project and the results from HIA are an important instrument for the establishment of further collaborations with local, regional and national entities and the creation of a communication network on air pollution and health.

Rome partners

Paola Michelozzi, Department of Epidemiology ASL RME, Rome - coordinator
Ursula Kirchmayer, Department of Epidemiology ASL RME, Rome

The municipality of the city of Rome has been involved in the activities concerning air pollution and health.

Further contacts with local, regional and national entities are to be made in the next few months.

ROUEN CITY REPORT

Background

The city of Rouen is located 120 km to the Northwest of Paris. It covers an area of 320 km^2 and, according to the 1999 census, has a population of approximately 434 924 inhabitants (15% 65 years +). The city has a large industrial area along the Seine. Sources of pollution are mainly industrial, particularly sulphur dioxide (93% of emissions are due to industrial activities). Rouen is situated in a basin surrounded by hills that, added to weak winds and/or thermal inversion phenomena, limit the dispersion of the air pollutants. There are mainly Southwest dominant winds, which push the air pollution of the industrial area towards the centre of the town. The morning fogs are rather frequent. The minimum and maximum temperatures average 6.2°C and 14.4°C, respectively.

Sources of air pollution

The city of Rouen's share of regional air pollution emissions is estimated at 16% for sulphur dioxide (SO_2) and 11% for nitrogen dioxide (NO_2). 93% of Rouen's SO_2 emissions are due to industry. Road traffic and industry share the responsibility for the NO_x emissions. (Source : CITEPA 1994).

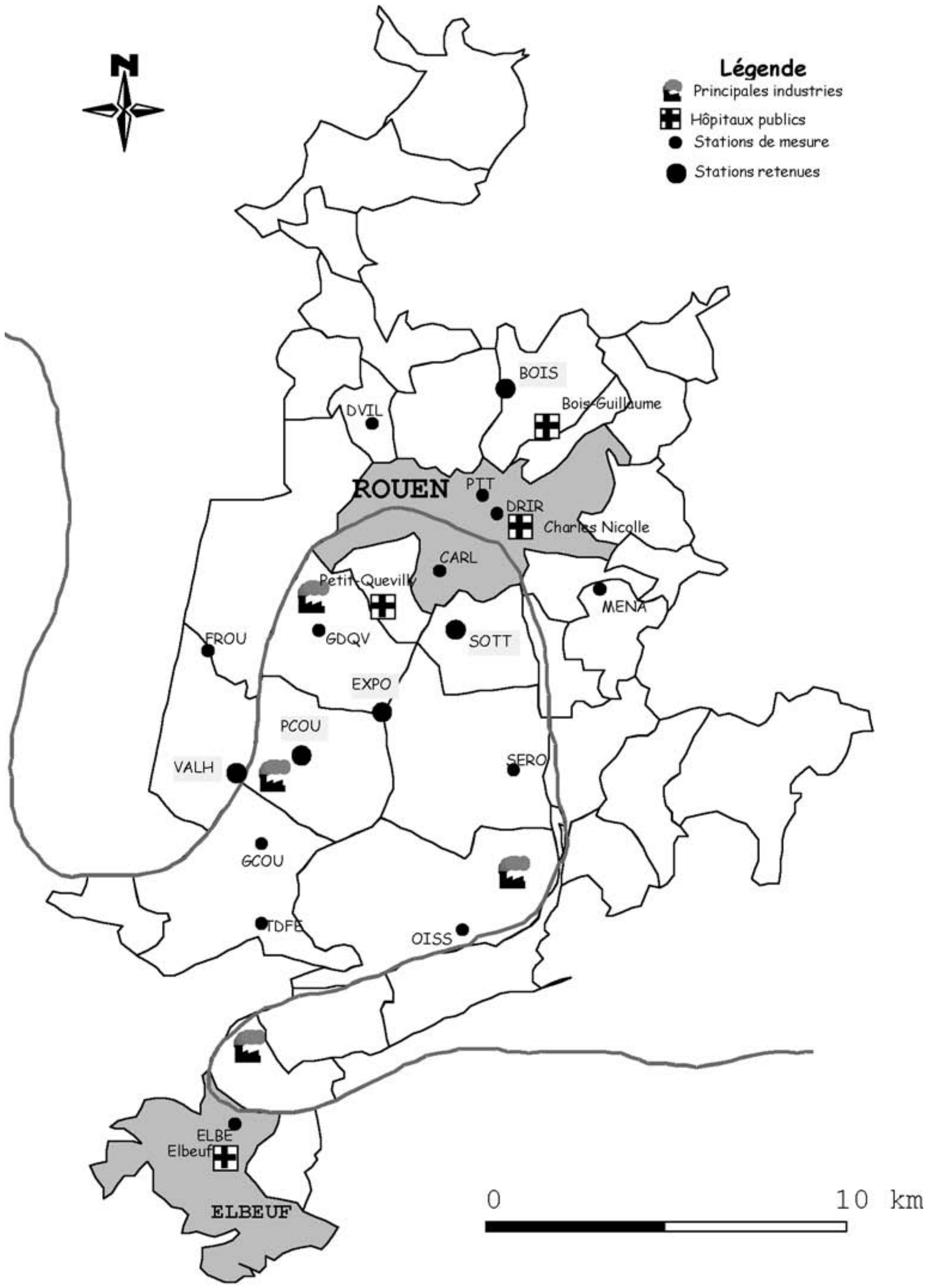
Exposure data

A permanent automated air pollution network (Air Normand) provided air pollution data. Black smoke (BS) concentrations were measured by reflectometry. The exposure indicator was constructed by calculating the arithmetic mean of daily concentrations recorded by 5 stations selected in the city area and traffic sources of pollution. The ambient urban stations had to be correlated (correlation $\geq$ 0.70) and had close mean levels of pollution. Weather data, temperature and relative humidity were obtained from Météo France.

For 1998:

- daily mean levels (SD) of BS were 9.8 $\mu g/m^3$ (14.0)
- the levels of BS reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 2.5 $\mu g/m^3$ and 19.2 $\mu g/m^3$
- number of days when BS exceeded 20 $\mu g/m^3$ was 34 days
- number of days when BS exceeded 50 $\mu g/m^3$ was 12 days.

Air pollution monitoring sites are given below.



Source IGN - AIR NORMAND 1998

Health data

Mortality data were provided by INSERM (National Institute of Health and Medical Research).

The age-standardised mortality rate using European population as a reference was 580 per 100 000 inhabitants.

Hospital admissions data was provided by the public hospital of Rouen metropolitan area. The daily numbers of respiratory hospital admissions (ICD9 [460 – 519]; ICD10[J00-J99]) among the 65 years old and more patients were extracted from the hospital information system "Programme de Médicalisation des Systèmes d'Information" (PMSI).

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 was 3.7 (2.35). The corresponding incidence rate was 5.6, that is 2 042.9 per 100 000 per year.

No data were available for cardiac admissions all ages (ICD9 410-414, 427, 428).

Health impact assessment

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:
- for a reduction of BS levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3
- for a reduction of BS levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3
- for a reduction by 5 µg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	12	1.4	0.7	1.9	0.3	0.2	0.4
20 µg/m^3	34	5.1	2.5	6.8	1.2	0.6	1.6
By 5 µg/m^3	NA*	10.5	6.1	14.8	2.4	1.4	3.4

NA: not applicable

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	12	0.1	0.0	0.8
20 µg/m^3	34	0.3	0.0	2.9

**na: not available*

Comments

Just as for the city of Le Havre, the health impact assessment was carried out in 1998, as it was the year with the most complete mortality and hospital admissions data available. With regard to BS, data from 1998 were also used. The BS exposure indicator was constructed by calculating the arithmetic mean of daily concentrations recorded by three ambient urban stations and two industrial stations selected in the city of Rouen. However, the descriptive analysis of these data shows that the concentrations recorded by these stations were correlated (correlation ≥ 0.70) and have close mean levels of pollution.

The French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels are described in the section on Bordeaux and concern all the cities involved in the PSAS-9 programme.

The Regional Plan for Air Quality in Haute-Normandie (PRQA)

In addition to the extension in the monitoring by the automated air pollution network (Air Normand), Haute Normandie will develop 3 types of plans:

- A Regional Plan for Air Quality aiming at defining the main trends of the regional policy in dialogue with all the local actors (government representatives, territorial and local communities, associations, etc.)
- Plans for Protection of the Atmosphere (PPA) for cities with over 250 000 inhabitants to reduce, by concrete actions, air pollution to a level lower than the European limit values
- Plans for Urban Transportation (PUD) for cities with over 100 000 inhabitants to organise transport, traffic and car parking so as to minimise their impact on air quality.

The DRIRE (Regional Office of Industry, Research and Infrastructure) is in charge of driving, under the authority of the Prefect, preparation of the PRQA and the PPA.

Rouen partners

Abdelkrim Zeghnoun – InVS-coordinator

P. Barco (DIM CH d'Elbeuf), C. Bel (Réseau de surveillance de la qualité de l'air-Air Normand), M. Bobbia (Réseau de surveillance de la qualité de l'air-Air Normand), P. Czernichow (Département d'Epidémiologie et de Santé Publique CHU de Rouen), M. Duclot (DDASS Seine Maritime), V. Delmas (Réseau de surveillance de la qualité de l'air-Air Normand), L. Froment (DESP CHU de Rouen), C. Tain (DRIRE Seine Maritime), F. Voisin (DIM CH d'Elbeuf).

SEVILLE CITY REPORT

Background

Seville is the political and administrative centre and capital of Andalusia, and is the largest region of Spain. It has about 700 000 people, 13.5% older than 65 years. It is situated on the Guadalquivir river, to the end of the valley. The municipality of Seville is 141 km^2 in size and is situated to the south-west of the Iberian Peninsula, about 80 km from the Atlantic ocean, and at 49 meters above sea level.

The climate is typically Mediterranean but has an important oceanic influence. It is a warm-mild climate, with little temperature variation during the year: warm, dry and long summers and mild winters. The annual mean temperature is 18.5ºC. July is the warmest month with a mean temperature of 27.8ºC, ranging from 21ºC to 35ºC. Maximum absolute mean temperatures reach 41.9ºC. January is the coldest month with a mean temperature of 11.7ºC, ranging from 7.5ºC to 16ºC. Minimum absolute mean temperatures reach 0.8ºC. In the summer, Seville often suffers from heat waves, several consecutive days with maximum temperatures above 40ºC. Monthly rainfall distribution fits the Mediterranean model, with maximum rainfalls in the autumn and winter, and pronounced minimum rainfalls in the summer.

Seville and its metropolitan area have an important radial system of communication infrastructures that provides them great territorial accessibility to the rest of Spain and Andalusia.

Sources of air pollution

Transportation constitutes the main source of air pollution in Seville and its metropolitan area. The air quality control system of stations does not cover the whole municipality, but presents an acceptable distribution, covering the urban area of the city, where more than 80% of the population resides.

In the year 2000, high ozone levels were the cause of all the negative environmental assessments. The reason for ozone peaks is the special weather conditions in the summer: strong sun radiation, calm wind situation, and transportation emissions, which lead to ozone levels above the maximum allowed concentrations.

Exposure data

The Surveillance System for Air Pollution has been gradually implemented in the city. It is run by the Regional Environment Department of the Andalusian Regional Government (as in all other Andalusian cities where the system is implanted). Seville has 10 air pollution monitoring stations. The six stations used for HIA are background stations. Only stations with more than 75% of hourly values, and more than three years of data, were selected. Stations are distributed across the urban area of Seville (see map below).

For 1999:

- daily mean levels (SD) of PM_{10} were 44.36 $\mu g/m^3$ (10.72)
- the levels of PM_{10} reached during the 36 days with the lowest (10^{th} percentile) and the highest (90^{th} percentile) levels were respectively 32.1 $\mu g/m^3$ and 58.9 $\mu g/m^3$
- number of days when PM_{10} exceeded 20 $\mu g/m^3$ was 365 days
- number of days when PM_{10} exceeded 50 $\mu g/m^3$ was 94 days.

Metereological data is provided by the National Institute of Meteorology.

Health data

Population data is from 1996 (Padron Municipal de Habitantes).

Mortality data comes from the Regional Register of Mortality, coded according to the International Classification of Diseases (ICD9).

The age-standardised mortality rate for Seville for 1999, using the European population as a reference, was 719 per 100 000 inhabitants.

Hospital admissions data on respiratory and cardiovascular causes come from the Andalusian Health Services Information Service, also coded using the international classification of diseases (ICD9).

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) was 4.71 (3.58).

Daily mean number (and SD) of cardiac hospital admissions all ages (ICD9 410-414, 427, 428) was 12.26 (4.72).

Baseline frequency was estimated based on the daily number of admissions.

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects:

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	94	8.6	5.7	11.4	1.2	0.8	1.6
20 µg/m^3	365	74.1	49.6	98.3	10.6	7.1	14.1
By 5 µg/m^3	NA*	17.3	11.5	23.1	2.5	1.6	3.3

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	94	5.5	2.2	8.7
20 µg/m^3	365	53.6	21.6	85.1
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	94	3.9	2.6	5.7
20 µg/m^3	365	33.8	22.7	48.4

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	43.9	26.7	61.1	14.7	8.9	20.5
20 µg/m^3	494.8	296.3	700.7	78.7	47.0	111.6
10 µg/m^3	706.5	419.4	1009.0	108.7	64.4	155.5
By 5 µg/m^3	117.1	71.1	163.5	16.8	10.2	23.4

Comments

According to HIA results, if the actual levels of PM_{10} were reduced, and all days with levels above 50 µg/m^3 were reduced to 50 µg/m^3, with other risks staying the same, about 9 deaths, 6 hospital admissions for cardiac diseases, and 4 hospital admissions for respiratory diseases, would be avoided annually. The expected benefits for reduced mortality in the long term if, according to the European directives for 2010, annual mean levels of PM_{10} are reduced to 20µg/m^3, are still greater. Over 494 attributable mortality cases could be avoided, which represent 78.7 cases per 100 000 inhabitants, of which almost 11 cases are related to short term mortality.

Seville will have to reduce current levels of air pollution to comply with air pollution directives in the future. Projects to increase and develop new ways to increase public transportation in the city are planned.

Seville partners

Antonio Daponte (coordinator), Inmaculada Aguilera, Silvia Toro, Ricardo Ocaña - Escuela Andaluza de Salud Publica, Granada, Spain.

STOCKHOLM CITY REPORT

Background

The study area, Stockholm metropolitan, includes 41 parishes and has a population of 1.16 million people, 15.6% older than 65 years. The population has been increasing, there were

1 021 000 inhabitants in the study area in 1988. Stockholm County has a total population of 1.8 million inhabitants. Stockholm has a sub-continental climate, and is situated next to the Baltic Sea, 13% of the total area being water, lakes or ocean. The mean temperature during the winter half year, October-March, is approximately 2°C, and the mean temperature during summer is 13°C. The yearly average temperature is 7.2°C (1984-1999), and the yearly average relative humidity is 73%. The average wind speed is 3.5 m/s (1984-1999), and the average precipitation is 539 mm (1961-1990).

Sources of air pollution

A detailed description of sources of particles in Stockholm in 1998 is presented in Johansson et al., (1999)[1] and Larnesjö et al. (2000)[2] (see references below). In the city centre road traffic is the dominating particle source. Approximately one third of the urban background PM_{10} concentration comes from local sources. For PM_{10}, locally generated road dust particles are very important especially during the spring and at street level.

In residential areas, emissions due to wood burning can be important. Even though there are very few wood boilers in Stockholm, there are several tens of thousands of wood stoves (stoves, fireplaces, small open furnaces). Long-range transported particles contribute to a large part of the total mass concentration in the urban background, especially for the finer $PM_{2.5}$ fraction.

So far, most measurements of particulate matter in urban areas and also in the city of Stockholm refer to the mass concentration (µg/m^3). Measurements of the particle size distribution in Stockholm are presented in Kristensson et al., (2001)[3]. This data indicates that exhaust emissions due to local road traffic have a large impact on the concentration of particles less than about 200 nm (diameter) due to exhaust emissions. There is also an important effect of local road traffic on the number of particles larger than about 600 nm (due to road dust re-suspension). But the influence on particle sizes between 200 nm and 600 nm is much smaller. This size fraction is mainly due to particles present in the air that come to the area.

At the beginning of the last century, heating was a major source of pollution due to many small wood and coal-heated furnaces. The 1960´s mean levels of sulphur dioxide in the central parts of Stockholm exceeded 100 µg/m^3, and during the winter months the 24-hour concentration could rise above 200 µg/m^3. The largest decrease in SO_2 concentration was seen between 1965 and 1972: in some parts of the city the levels decreased by approximately 100 µg/m^3. This dramatic decrease was

[1] Johansson C, *et al.*, 1999. NO_2 and Particulate matter in Stockholm - Concentrations and population exposure. *The Stockholm Study on Health effects of Air Pollution and their Economic Consequences*. 1999, Swedish National Road Administration: Stockholm.

[2] Larnesjö P, *et al.*, 2000. Emissions of PAH, particles and volatile organic compounds (in Swedish). *Stockholms och Uppsala läns Luftvårdsförbund*, 2000: 7.1.

[3] Kristensson A, *et al.*, 2001. Particle size distributions in urban air and in a road tunnel. Annual Report of SATURN/EUROTRAC2. *International Scientific Secreteriat, GSF-forschungszentrum für Umwelt und esundheit GmbH*, München, Tyskland.

a result of the expansion of district heating, and the regulation of the amount of sulphur in heavy oils used for heating.

Meanwhile emissions from heating related combustion sources decreased, and traffic was becoming the main source of air pollution in the city of Stockholm. The urban background levels of NO_2 were rather stable during the period 1982-1989, despite the increasing traffic, and the yearly urban background averages were approximately 30 $\mu g/m^3$. In 1989, the Swedish government decided to implement restrictions concerning exhaust fume emissions on newly built cars. In practice, this meant restrictions against new cars without catalytic equipped engines. This had positive effects on the NO_x emissions, and the urban background levels fell.

These actions have had positive effects on the air pollution levels in Stockholm, not only on the levels of NO_x and SO_2 but also on the concentrations of black smoke, CO and hydrocarbons.

In 1996, an environmental zone was created around the city centre. This means that trucks and buses that do not fulfil predetermined demands on age (max. 8 years) and emissions are not allowed to travel through the city centre. The result has been lowered emissions of particles and nitrogen dioxide, and decreasing noise levels.

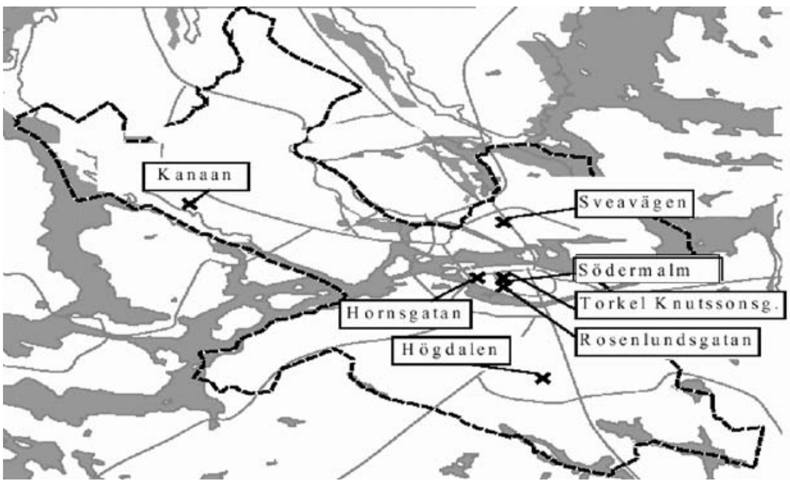
Exposure data

The monitoring network in Stockholm includes both roof level and street level measurements, and for some pollutants different methods are being used. A complete description of current instrumentation and details on the measurement sites are given in Swedish at www.slb.mf.stockholm.se/slb/r2_rapport.htm).

In this Apheis health impact assessment (and in APHEA2), PM_{10} data for Stockholm is from the original roof top station Rosenlundsgatan. Simultaneous measurements of PM_{10} and $PM_{2.5}$ are now performed at two sites in Stockholm, a rooftop site and at street level (Hornsgatan), and at one site in Sollentuna (close to the highway to Uppsala).

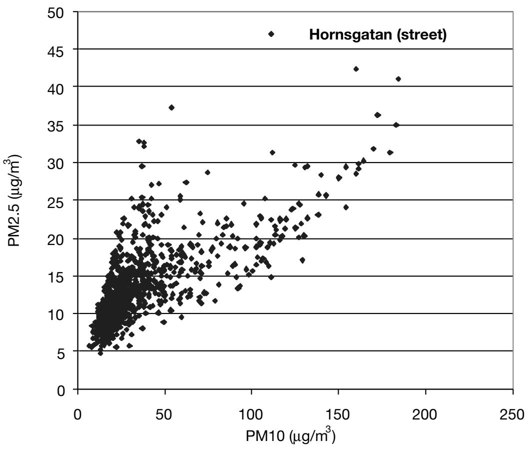
Background data are obtained from the measurements performed by ITM (Stockholm University) at Aspvreten. It has been estimasted that on average 5 $\mu g/m^3$; PM_{10} at roof level in the city centre is of local origin.

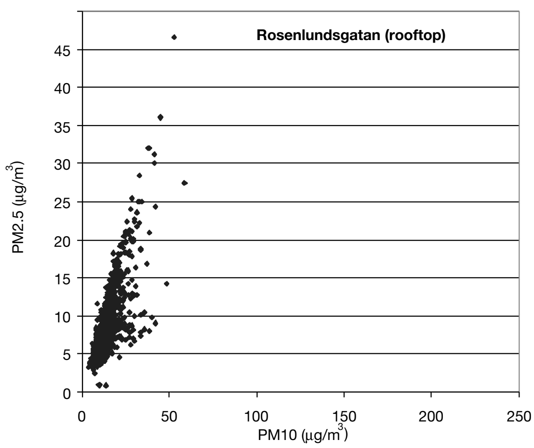
Since May 2001, total particle number concentrations are measured regularly at a rooftop site and since October 2001 at a street level site in central Stockholm.



The distance between station Hornsgatan and station Sveavägen is approx. 2 700 meters.

PM_{10} and $PM_{2.5}$ levels from 2000/2001 have been compared at a rooftop and traffic site in central Stockholm. The main difference is the lack of high concentrations at the rooftop site; only two values are higher than 50 $\mu g/m^3$. The average PM_{10} concentration at street level (Hornsgatan) is 39 $\mu g/m^3$ at the rooftop site the corresponding value was 14 $\mu g/m^3$. Whereas PM_{10} is almost 300% higher at street level, $PM_{2.5}$ increases only by about 60%.





Comparison of $PM_{2.5}$ and PM_{10} levels (daily averages) at street level and at rooftop (station used in Apheis and APHEA2) in Stockholm.

There are five meteorological masts in the region. They provide hourly data on a number of parameters. In the southern part of Stockholm, there is a 50 metre high mast equipped with several meteorological instruments. The parameters are: wind speed (two heights), wind direction (one height), temperature (absolute and difference between two heights), global radiation, relative humidity, precipitation (hourly). In the top of the mast there is a sonic anemometer that gives information on the turbulence.

For the year 2000:
- daily mean levels (SD) of PM_{10} were 14.0 µg/m^3 (5.3)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 7.4 µg/m^3 and 24.0 µg/m^3
- the number of days when PM_{10} exceeded 20 µg/m^3 was 49
- there were no days when PM_{10} exceeded 50 µg/m^3.

Health data

The Centre for Epidemiology (EpC) is a part of the Swedish National Board of Health and Welfare (http://www.sos.se/epc/epceng.htm.), and is responsible for national health registers used in Apheis, the Cause of Death Registry and the Hospital Discharge Registry.

Statistics Sweden is however entrusted by the EpC with the actual compilation of the mortality statistics. Only 0.8% of cases are lacking cause of death. Information to the Hospital Discharge Registry is delivered once a year to EpC from each of the 26 county councils in Sweden. The completeness of more than 99% and a low frequency of missing cause (1%) give the register a high quality. However, the delay in national data processing means that baseline data used here are for 1999.

The age-standardised mortality rate for Stockholm using the European population as a reference was 578 per 100 000 inhabitants.

The number of acute respiratory hospital admissions 65 years + (ICD9 460-519) was 2 789 per 100 000 persons aged 65+.

The number of acute cardiac hospital admissions all ages (ICD9 410-414, 427, 428) was 999 per 100 000 persons all ages.

Transformation from ICD-10 to ICD-9 has been done as I20-25=410-414, I46-49=427, I50=428.

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	0	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	49	9.0	6.0	12.0	0.8	0.5	1.0
By 5 µg/m^3	NA*	34.1	22.6	45.5	2.9	1.9	3.9

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	0	0.0	0.0	0.0
20 µg/m^3	49	7.9	3.2	12.7
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	0	0.0	0.0	0.0
20 µg/m^3	49	6.2	4.1	9.0

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10})

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 μg/m^3, and by 5 μg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 μg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 μg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
10 μg/m^3	184.5	112.1	257.4	15.8	9.6	22.1
By 5 μg/m^3	230.4	139.9	321.6	19.8	12.0	27.7

Comments

Only one urban background monitoring station for PM_{10} is used to estimate the exposure for Stockholm in this study. It is the same station that was used in the APHEA2 study. Since there are no important point sources, the above roof level is not expected to vary much across the city. The level of PM_{10} in a busy street is however found to be three times higher on average.

Stockholm has already low air pollution levels from an international point of view. Diesel cars are much less common than in many other parts of Europe, and the vehicle fleet is kept in good condition. However, findings from this HIA show that even small reductions in PM_{10} levels would lead to a decrease in the number of short and long-term deaths in Stockholm.

For PM_{10} levels close to streets in the city centre, the main cause of exceeding of the limit value is re-suspension of road dust. At present, no actions have been taken to reduce road dust re-suspension in Stockholm. At the other end of the size spectrum, the ultra-fine particles are mainly due to local road traffic exhaust. There is no limit value for these particles; their contribution to PM_{10} is almost negligible.

In Stockholm, there is now an environmental zone in the city centre. The main purpose of this zone was to encourage the use of cleaner vehicles, improve air quality and to some degree reduce noise. The zones target trucks and buses. Calculations have shown that particulate matter emissions due to heavy-duty vehicle emissions within the zone have been reduced by about 40% compared to the situation without the zone. But the corresponding reductions of the atmospheric mass concentrations are only up to 9% for $PM_{0.2}$. However, the influence of heavy-duty vehicles on the concentration of particles is more important than if the mass concentration is considered.

The importance of wood burning in the outskirts is not known. Calculations indicate that it can be a very important source in residential areas, but the lack of knowledge on the amount of fuel actually used together with uncertainties concerning emission factors make these estimates very tentative. New stoves and boilers have much lower emissions as compared to old ones normally used today. But the number of installations of stoves in residential areas tends to increase. So far, the local authorities have run information campaigns to make people aware of the problems associated with wood burning in densely populated areas.

Stockholm partners

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Bo Segerstedt - Umeå University

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Swedish Environment Protection Agency - Carl-Elis Boström, Tula Ekengren, Britta Hedlund
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National Board of Health and Welfare – Marie Becker
IVL Swedish Environmental Reseach Institute - Karin Sjöberg
NGOs: The Swedish Society for Nature Conservation, The Swedish Astma & Allergy Association

We are also grateful to Curt-Lennart Spetz and Leif Forsberg at The Centre for Epidemiology, Swedish National Board of Health and Welfare, for help with the health register data.

STRASBOURG CITY REPORT

Background

The study area covers the metropolitan area of Strasbourg, called Communauté Urbaine de Strasbourg (C.U.S.), with a relatively young population of 451 133 inhabitants (13.3% older than 65 years) distributed in 27 communities, covering 304 km^2, with a population density of 1 484 inhabitants/km^2.

It is located in the valley called Fossé rhénan (with the Vosges to the West and the Black Forest to the East), which encourages the stagnation of air in the entire region and increases the dome phenomena of urban pollution. It has an oceanic climate with a continental influence. Average temperature ranges from 6.5°C to 15.2°C. Relative humidity is 55.8%.

In 1997, in the metropolitan area of Strasbourg, 1 070 000 journeys were recorded per day. Yet Strasbourg takes many measures to improve air quality (new traffic plan for the city centre, tramway, better public transport, new pedestrian spaces, cycling tracks, green spaces, etc…).

The Regional Plan for Air Quality (PRQA) was definitively approved in December 2000. It describes the air quality situation, emissions sources, the various actions that have been taken locally and lists the various guidelines aimed at improving air quality surveillance, the guidelines on emission controls and on information to the public.

Sources of air pollution

SO_2 emissions come mainly from industry (70% in 1997) and to a lesser extent from residential/third sector (24% in 1997). Particle sources are divided more homogeneously among the three main types (in 1997, 40% for residential/third sector, 26% for industry and 34% for transport). Particle emissions in small heating installations are mainly due to wood (97%). NO_x emissions are mainly due to traffic (in 1997, 65%) but also to industry (25%) and to residential/third sector (10%). Non-methanic VOC in 1997 are due to industry (38%), traffic (25%) and residential/third sector (15%). Benzene emissions, in particular, are due mainly to transport (75%). CO emissions are due to residential/third sector and transport (43% and 55%, respectively in 1997). (Sources: CITEPA, 1997; LPCA – Plan de Protection Atmosphérique Strasbourg/Kehl, 1990)

Exposure data

The air quality network for the Alsace region, called ASPA (association pour la surveillance et l'étude de la pollution atmosphérique en Alsace), has 11 sites spread throughout the metropolitan area of Strasbourg. The measured pollutants are SO_2, particles, nitrogen oxides, O_3, CO, CO_2 and Pb.

No BS data was available. PM_{10} is measured at one urban site (Strasbourg city centre) since 13/05/98. The data are well correlated since 1999 (0.97) with PM_{13} measures from a traffic site (Strasbourg Illkirch).

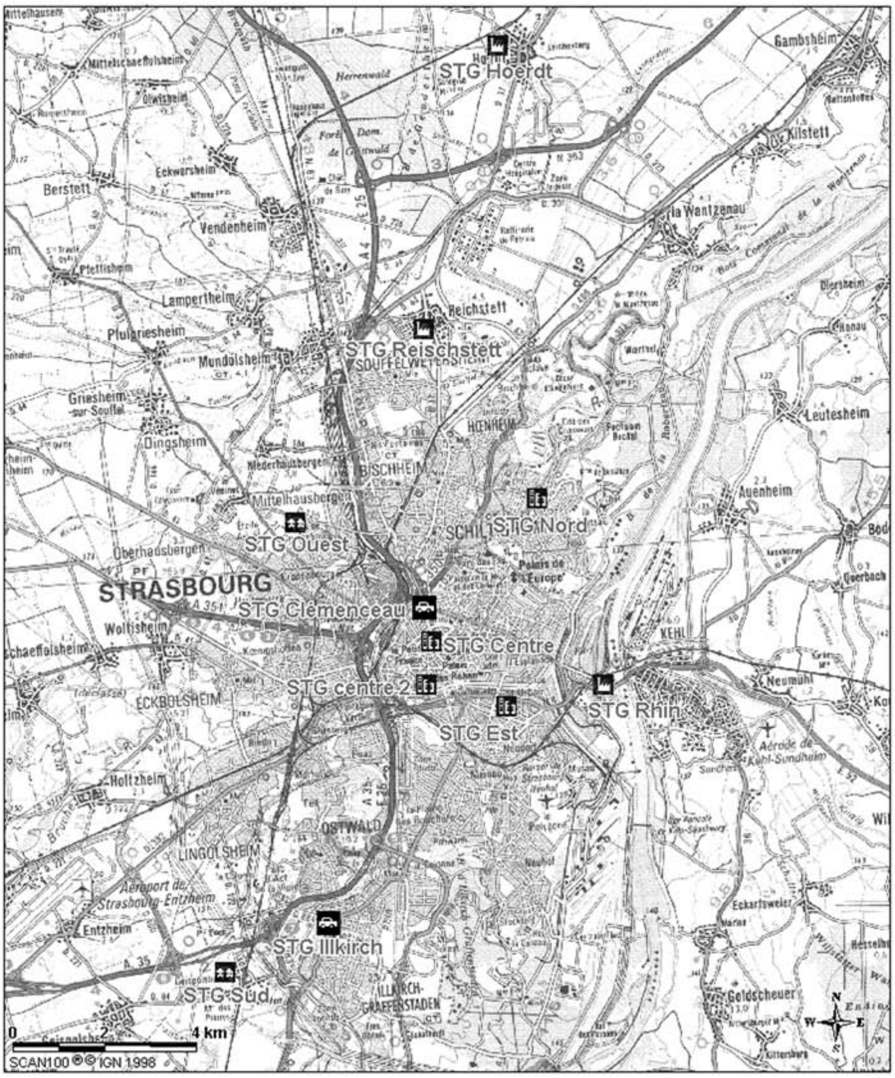
The means of the two series are very close too (21.2 µg/m^3 for PM_{13} and 22.0 µg/m^3 for PM_{10}). Standard deviations for the distribution of these two series are also close (12.0 µg/m^3 and 11.1 µg/m^3, respectively). Moreover, the particles indicator for the HIA was calculated from the arithmetic mean of these two indicators in 1999. This calculation could have been done from the sole PM_{10} series but, to remain coherent with the analysis conducted as part of the PSAS-9, it was decided to keep the combined indicator. The missing values were replaced according to the decisions of the PSAS-9.

For 1999:

- daily mean levels (SD) of PM_{10} were 22.3 µg/m^3 (10.9)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 10.4 µg/m^3 and 36.0 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 176 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 6 days.

Air pollution monitoring sites are given below.

Réseau des stations de mesure des polluants atmosphériques de l'ASPA sur la Communauté Urbaine de Strasbourg au 01/01/2002



Types de station : Industielle, Péri urbaine, Urbaine, Trafic, Rurale

Health data

The information department specialised in mortality data (SC8) at the National Health and Medical Research Institute (INSERM) provides medical causes of death based on the international classification of diseases (ICD9). The daily number of deaths for each city corresponds to the total no-accidental mortality: codes ICD9 < 800. The selection was made according to the main causes of death.

The age-standardised mortality rate using the European population as a reference was 531 per 100 000 inhabitants.

Data on hospitalisations for respiratory and cardiovascular diseases are provided by the Medical Information Department or DIM (Département d'Information Médicale) at each of the 5 medical care centres and of the 4 hospitals that provide health care to the inhabitants of the studied urban area. Through the hospital information system (PMSI), the daily numbers of admissions for respiratory diseases (ICD9 [460 – 519]; ICD10[J00-J99]) were taken from patients aged 65 years +.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 was 1.95 (1.5). The corresponding incidence rate was 1186.6.

No data are available for cardiac admissions all ages (ICD9 410-414, 427, 428).

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	6	0.5	0.4	0.7	0.1	0.1	0.2
20 µg/m^3	176	10.6	7.1	14.1	2.3	1.6	3.1
By 5 µg/m^3	NA*	9.2	6.1	12.3	2.0	1.4	2.7

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	6	0.2	0.1	0.3
20 µg/m^3	176	3.7	2.5	5.4

**na: not available*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	28.7	17.5	40.0	6.4	3.9	8.9
10 µg/m^3	150.3	90.7	211.2	33.3	20.1	46.8
By 5 µg/m^3	62.3	37.9	87.0	13.8	8.4	19.3

Comments

The HIA conducted in Strasbourg used the particle levels measured in 1999 and the 1998 health indicators (total mortality, hospital admissions for respiratory diseases of 65 years +). The particle indicator is built as a mean of daily PM_{10} levels (measured at an urban station) and daily PM_{13} levels (traffic station) after checking the correlation of the two series and after having checked that their mean levels are almost similar.

The expected benefits of a reduction of particle levels is the highest for the 10 µg/m^3 level and are lower for the 20 µg/m^3 level. This is explained by the fact that the PM_{10} mean levels are already close to 20 µg/m^3, which is the objective set for 2010. Also, the benefits of reducing annual PM_{10} levels by 5 µg/m^3 are not negligible.

Since 1997 the ASPA implements public information and alert guidelines on fine particles, based on thresholds averaged on a 24-hour period (level 2: 80 µg/m^3; level 3: 125 µg/m^3).

Many measures have been taken to reduce particle emissions: more public transport (longer tramway lines and creation of new tramway lines), restriction on parking time in town, bicycle rental, park-and-ride, clean boiler campaigns, exchange of information and know-how with broader regions (Switzerland, Germany).

The French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels, are described in the section on Bordeaux and concern all the cities involved in the PSAS-9 programme.

The PRQA for the Alsace region was definitively approved in December 2000. The resulting document (available on paper and on CD-ROM) assesses the quality of air (distribution of background pollution, profiles of pollution), the sources, the various local projects (Pôle strasbourgeois of the PSAS-9 programme, the sentinel network on general practionners, RAMSES) and expresses the various propositions aiming at improving the surveillance of air quality, the clauses on emission control as well as informing to the population. The report also lists the teams and existing organisations that contribute to the knowledge of air quality and its effects on the environment.

In May 2001, the first meeting of the follow-up technical committee of the PRQA took place. The role of this committee is to coordinate the follow-up of the PRQA, to inform and increase public awareness, to encourage actions aiming at the improvement of air quality. It consists of project groups stemming naturally from working groups of the PRQA. The groups are “Information and communication”, “Energies”, “Air quality surveillance”, “Mobile sources”, “Fixed sources” and “Effects on health”. Suggestions and wishes of the latter project group are centred on the support brought to the epidemiological studies on the short and long-term effects on asthma and allergies, and to the study of indoor air pollution.

Concurrently to the follow-up of the PRQA, and going back to the law on air, a workgroup on air and health was established with one objective: to reflect on the implementation of a regional system of air quality surveillance and its effects on the environment and health.

Strasbourg partners

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N. Roeslin (DIM Hospices Civils de Strasbourg)
A. Target (ASPA)
C. Weidmann (DIM Hospices Civils de Strasbourg).

TEL AVIV CITY REPORT

Background

The Tel Aviv metropolitan area has a population of above 1.1 million people, 14.2% older than 65 years. The district of Tel Aviv is one of six districts of the country.

About 20% of the population lives in Tel Aviv district, the area of which is only less than 1% of the total area of the country. Hence, it is by far the most heavily populated district in Israel (about 6 650 inhabitants/km^2).

The climate is subtropical. The average temperature is about 20^{o}C with a minimum of about 10^{o}C and a maximum of 32^{o}C. The average annual rainfall is 532 mm, the rainy season is between November and April with an annual average of 64 rainy days. The annual average relative humidity is about 65% with a minimum of 12% and a maximum of 93% relative humidity.

Air pollution peaks (in µg/m^3) are as follows:

Summer peaks: SO_2 - 47.4, NOx - 498.1, O_3 – 66.4, PM_{10} – 137.7.

Winter peaks: SO_2 – 57.01, NOx – 600.2, O_3 – 58.7, PM_{10} – 200.6.

Sources of air pollution

Transportation constitutes the main source of air pollution in the Tel Aviv metropolitan area: about 65% of the emissions of nitrogen oxides, 90% of the emissions of carbon monoxide, 60% of the emissions of CO_2 and 68% of the emissions of hydrocarbons are emitted from cars.

Exposure data

The pollution indicators are monitored by the Ministry of the Environment and by the Israeli Electric Corporation (IEC). In 1996, PM_{10} data from two monitoring stations of the IEC network were available. All the stations were installed at a height of about 10 m. All of them were used for HIA (stations SL and TM indicated on the map of monitoring sites in Tel Aviv). At that time there were no traffic related stations.

We used 24-hour average values. The daily mean value of one station is selected only if more than 75% of hourly values are available.

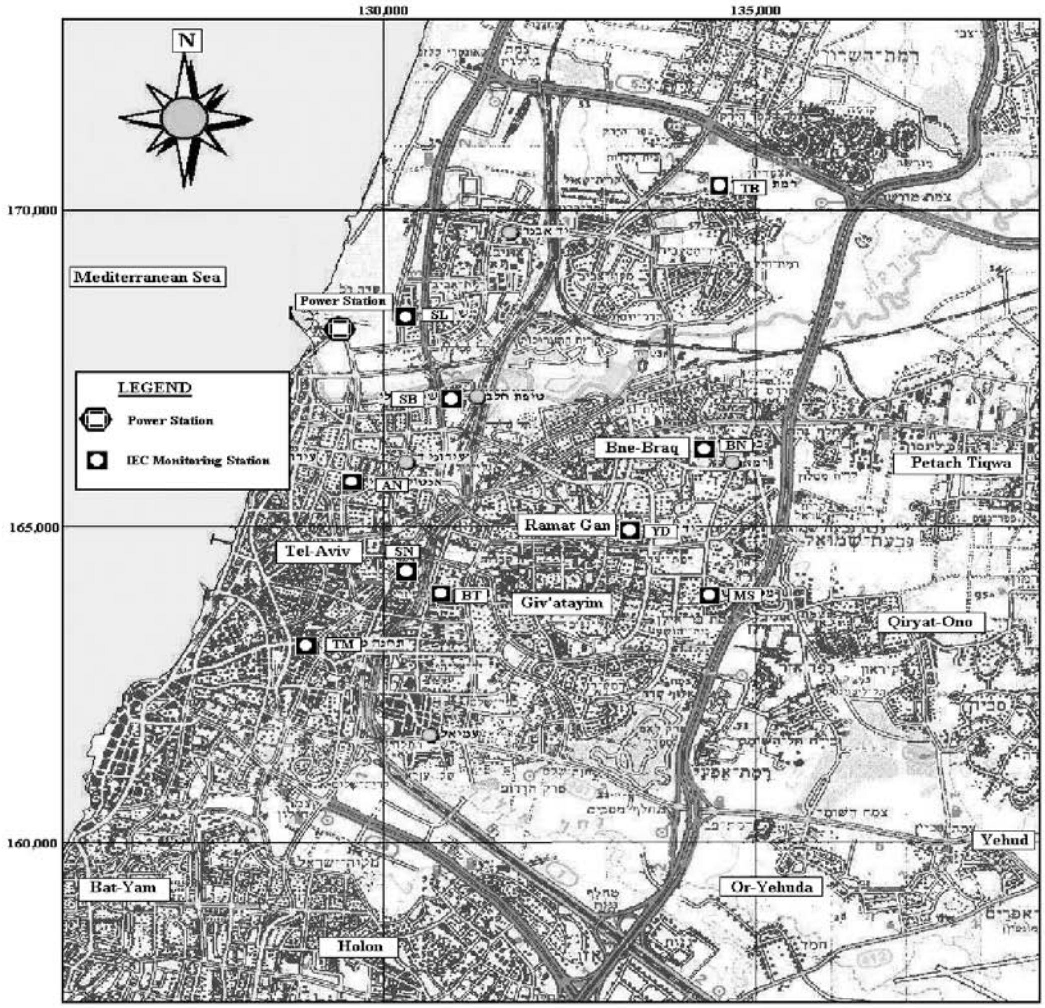
For 1996:

- daily mean levels (SD) of PM_{10} were 56.4 µg/m^3 (97.8)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 24 µg/m^3 and 78 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 351 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 109 days.

Tel Aviv Metropolis Map

City of Tel Aviv and the Surrounding Towns

Monitoring Stations Network



Map Scale 1:114000
source: Israeli Electrical Company

Meteorological data were provided by the Israeli meteorological service.

The data includes, on a daily basis, minimum, mean, maximum temperature and relative humidity from the central meteorological station in Bet-Dagan (about 10 km south-east of Tel Aviv).

Health data

The department of information in the Ministry of Health provides the mortality data as well as hospital admission data, coded using the international classification of diseases (ICD9).

The age-standardized mortality rate for Tel Aviv using the European population as a reference was 672 per 100 000 inhabitants.

In 1996 there were 5 855 respiratory admissions of persons 65+ years old (ICD9 460-519) in Tel Aviv district.

There were 20 549 cardiac admissions among all age groups (ICD9 410-414, 427, 428).

Health impact assessment

For PM_{10} measurements we developed the short- and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

- for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
- for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction by 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	109	58.4	39.1	77.6	5.0	3.3	6.6
20 µg/m^3	351	175.7	117.9	232.9	14.9	10.0	19.8
By 5 µg/m^3	NA*	30.6	20.3	40.9	2.6	1.7	3.5

**NA: not applicable*

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	109	131.0	52.8	208.2
20 µg/m^3	351	363.3	146.9	575.2
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	109	66.4	44.6	95.0
20 µg/m^3	351	183.5	123.6	261.4

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m^3 (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m^3 (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m^3 (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m^3 in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m^3, and by 5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable deaths per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m^3	617.7	371.5	870.6	52.5	31.6	74.0
20 µg/m^3	1315.4	777.9	1886.2	111.8	66.1	160.3
10 µg/m^3	1642.9	963.2	2376.5	139.6	81.8	201.9
By 5 µg/m^3	206.9	125.6	288.8	17.6	10.7	24.5

Comments

Air pollution in Tel Aviv

SO_2 emissions from the power plant located in the northern part of Tel Aviv have been drastically reduced during the last two decades, due to a shift towards the use of low (1%) and very low (0.5%) sulfur fuel. As a result, SO_2 levels decreased by about one order of magnitude. On the other hand air pollution emissions from traffic increased substantially during this same time period.

The municipality of Tel Aviv and the Ministry of Transportation have been planning for a long time a convenient public transportation system from the suburbs of Tel Aviv (Ramat-Gan, Ramat-Hasharon, Petach-Tikwa etc.) into the city, in order to reduce traffic density as well as air pollution. The moment this system will be operating, the number of private cars in Tel Aviv will decrease, and as a by-product traffic related air pollution will also decrease.

Recently the buses, which are the most common mean for public transportation, are being replaced by newer and environmentally friendly ones, according to the EC standards. This change is also expected to reduce air pollution.

HIA

Since we use the RR for PM_{10} for Europe for the calculation of HIA in Tel Aviv, and since PM_{10} levels in Tel Aviv are relatively high, partly due to natural sources, we get relatively high values resulting from HIA calculations.

Environmental Health Studies

In a health study carried out by our department among 2 472 second to sixth grade schoolchildren in Tel Aviv in 1991, we found elevated frequencies of respiratory symptoms and diseases in the central (traffic-polluted) part of Tel Aviv compared to the suburbs. These data are used by environmental activists trying to promote the improvement of means of mass transportation to, from and in Tel Aviv.

Tel Aviv partners

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Mrs. Ziona Chaklai – Department of information – head, Ministry of Health

Mrs. Nehama Stein – Department of information, Ministry of Health

Mrs. Aviva Trachtmann – Air quality monitoring center, Ministry of the Environment.

Dr. Shmueli – Department of air quality, the Israel Electric Corporation, Haifa.

TOULOUSE CITY REPORT

Background

Situated in the plain of the south-west of France, with an oceanic climate but with warm summers, Toulouse is swept by a cool and wet, West wind, and by the strong and dry Autan wind (SE). Many rainfalls are brought in from the ocean: 628 mm of water for 95 days of rain in 1995. The minimum and maximum temperatures are on average 9.6°C and 18.7°C. Minimum relative humidity is 53.5%.

The study area includes 62 municipalities, that is 690 162 inhabitants (13.5% older than 65 years) on a 635 km^2 area. It therefore has a low population density compared to other urban centres. It is also characterised by heavy traffic between the suburbs and the town centre, mainly with the use of private cars. In 1996, out of 2.5 million journeys, 63% is done by car. Nevertheless, between 1990 and 1996, this percentage seems to be stabilising, probably thanks to the new subway that opened in 1993.

The air quality regional plan (PRQA) was made public in 1999 and allowed assessing the air quality situation and suggesting guidelines on actions to be taken against polluting sources.

Sources of air pollution

Road transports constitute the main source of atmospheric pollution. Even if one takes into account sulfur dioxide, which is typically a pollutant from industrial or domestic source, road transport is the main source of pollution: 40.9% versus 31.0% for the domestic part and third sector activities, and 26.5% for the industry, treatment of waste, extraction and transfer of energy. For nitrogen oxide, the part due to road transport amounts to 74.1%. One must note that this balance did not concern particles, which were measured only from 1999 for the metropolitan area of Toulouse. *(Source: CITEPA données de 1994).*

Exposure data

The pollution indicators have been provided by the Toulouse air-quality network ORAMIP.

This network has on the whole 13 stations for the metropolitan area of Toulouse and measures seven different pollutants (see map below). The explosion, on September 21, 2001, of the chemical industrial site AZF destroyed three stations: two urban sites (Maurice Jacquier and Léo Lagrange) and one traffic site (AFPA).

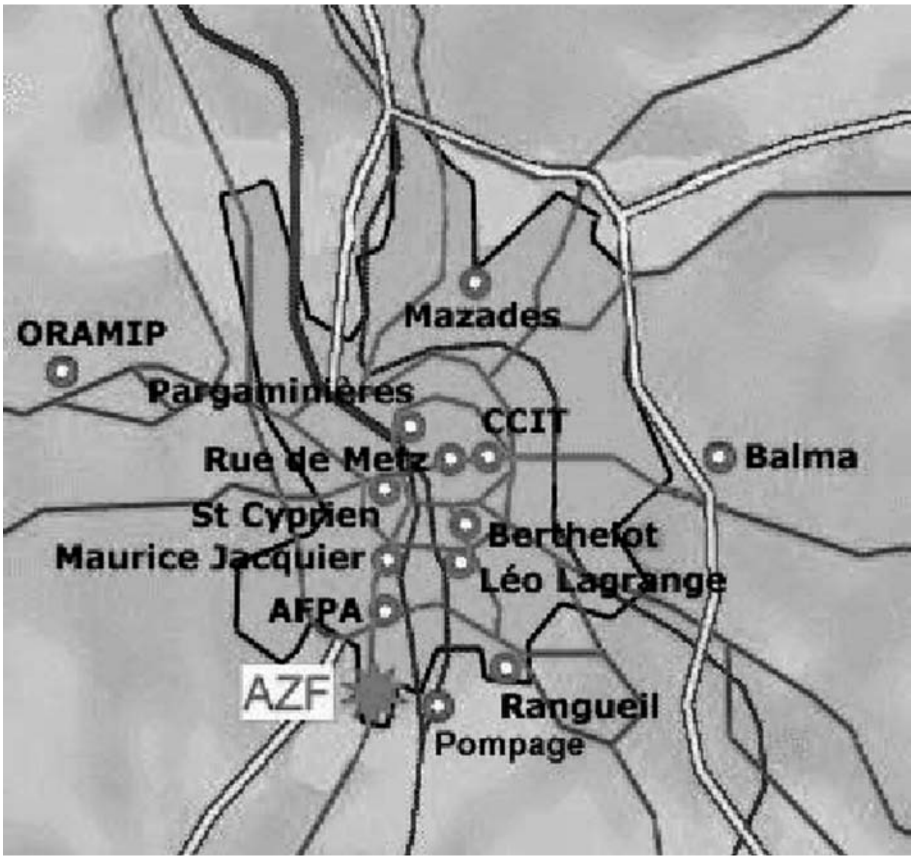
Black smoke was never measured in Toulouse. PM_{10} are measured by the network since respectively 30/04/99 and 28/05/99 for both urban sites (M. Jacquier et Berthelot), and since 07/08/99 for the traffic site (CCIT). The data selected for the HIA were measured over the year 2000 by both urban stations, that are not influenced by a punctual source of pollution. Over this period, the interquartiles of both stations overlap each other and the coefficient of correlation for both series is 0.7. A PM_{10} indicator was hence built from these data by the daily arithmetic mean of the measures of these two stations.

When one or several daily data were missing on one or both sites (more than 25% of the hourly missing data within 24 hr), the method of seasonal mean or of linear regression was used for replacement, depending on how long the data had been missing for.

For 2000:

- daily mean levels (SD) of PM_{10} were 17.9 µg/m^3 (8.3)
- the levels of PM_{10} reached during the 36 days with the lowest (10th percentile) and the highest (90th percentile) levels were respectively 9 µg/m^3 and 29 µg/m^3
- number of days when PM_{10} exceeded 20 µg/m^3 was 115 days
- number of days when PM_{10} exceeded 50 µg/m^3 was 1 day.

Air pollution monitoring sites are given below.



Source: ORAMIP

Meteorological data have been provided by Météo-France for all the PSAS-9 cities.

Health data

The information department specialised in mortality data (SC8) at the National Health and Medical Research Institute (INSERM) provides medical causes of death based on the international classification of diseases (ICD9). The daily number of deaths corresponds to the total non-accidental or unknown mortality: codes ICD9 < 800. The selection was made according to the main causes of death.

The age-standardised mortality rate for Toulouse, using the European population as a reference was 456 per 100 000 inhabitants.

Data on hospitalisations for respiratory and cardiovascular diseases are provided by the Medical Information Department, called DIM (Département d'Information Médicale), at each of the two public hospitals that provide health care to the inhabitants of the studied urban area. From the information systems medicalisation programme (PMSI), the daily numbers of admissions for respiratory diseases (ICD9 [460 – 519]; ICD10[J00-J99]) were taken for patients aged 65 years and over.

The daily mean number (and SD) of respiratory hospital admissions 65 years + (ICD9 460-519) for 1998 was 2.8 (2.1). The corresponding incidence rate was 3.0 per 100 000 inhabitants, that is 1 096.9 per 100 000 per year.

No data was available for cardiac admissions all ages (ICD9 410-414, 427, 428).

Health impact assessment

For PM_{10} measurements we developed the short and long-term exposure, or acute and chronic effects scenarios.

Acute effects

We used three scenarios to estimate the acute effects of short-term exposure to PM_{10} on mortality and hospital admissions over one year:

– for a reduction of PM_{10} levels on all days above a 24-hour value of 50 µg/m^3 to 50 µg/m^3 (2005 and 2010 limit values for PM_{10})
– for a reduction of PM_{10} levels on all days above a 24-hour value of 20 µg/m^3 to 20 µg/m^3 (to allow for cities with low levels of PM_{10})
– for a reduction by 5 µg/m^3 in the 24-hour daily values of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3, above 20 to 20 µg/m^3 and all days by 5 µg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 µg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 µg/m^3	1	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m^3	115	6.9	4.6	9.2	1.0	0.7	1.3
By 5 µg/m^3	NA*	12.8	8.5	17.1	1.9	1.2	2.5

NA: not applicable

Table 2. **Potential benefits of reducing daily PM_{10} levels above 50 to 50 µg/m^3 and above 20 to 20 µg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of PM_{10}**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 µg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 µg/m^3	na*	na	na	na
20 µg/m^3	na	na	na	na
Hospital admissions for respiratory diseases (+65)				
50 µg/m^3	1	0.0	0.0	0.0
20 µg/m^3	115	2.5	1.7	3.7

**na: not available*

Chronic effects

We used four scenarios to estimate the chronic effects of long-term exposure to PM_{10} on mortality over one year:

- for a reduction of the annual mean value of PM_{10} to a level of 40 µg/m³ (2005 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 20 µg/m³ (2010 limit values for PM_{10})
- for a reduction of the annual mean value of PM_{10} to a level of 10 µg/m³ (to allow for cities with low levels of PM_{10})
- for a reduction of 5 µg/m³ in the annual mean value of PM_{10} (to allow for cities with low levels of PM_{10}).

Table 3 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 3. **Potential benefits of reducing annual mean values of PM_{10} to levels of 20 and 10 µg/m³, and by 5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{10}**

	Attributable cases per year					
	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
40 µg/m³	0.0	0.0	0.0	0.0	0.0	0.0
20 µg/m³	0.0	0.0	0.0	0.0	0.0	0.0
10 µg/m³	136.1	82.4	190.5	19.7	11.9	27.6
By 5 µg/m³	86.7	52.6	121.0	12.6	7.6	17.5

Comments

From these results, one can observe in Toulouse PM_{10} values that are already in compliance with the limit values foreseen by the directive for 2005 and 2010. But even a small reduction in PM_{10} levels (5 µg/m³) leads to a non-negligible decrease in the number of long-term deaths. Moreover, because of its climatic conditions, Toulouse air pollution is more photo-oxydant with high levels of ozone, and the impact of ozone on health is not included in this report, and is linked to its geographical situation.

From a methodological point of view, the year 2000 was the only complete year of available data for PM_{10}, whereas health data was available only until 1998.

Besides, the extraction of the hospital admissions data could be done for the population living in the zone exposed to the measured PM_{10} levels. These data therefore allowed calculating real incidence rates.

The French regulations on monitoring air pollution and its health effects, and the steps planned to reduce air pollution levels, are described in the section on Bordeaux and concern all the cities involved in the PSAS-9 programme.

As mentioned previously, emissions due to road transports are the main source of pollution in Toulouse even if the creation of the subway enabled stabilizing the number of car users between 1990 and 1996.

As part of the PDU in 2000, three scenarios for future urban transport planning were considered. The first scenario, taken as a reference, was that no particular measures were to be taken, apart from the ones already planned. The second scenario includes the development of the metro, the bus network as well as the urban and long distance railroad network. The third scenario is more ambitious and suggests completing the public transport network with a system of automatic buses (with combined electric and thermal power supply), more frequent and faster buses thanks to a new layout of the roads, the postponement of any new road projects, a lot more cycle tracks.

Modelling as regards to traffic was conducted on these three scenarios: it appears that the last scenario would allow achieving the objectives set by the law on air quality as regards the use of public transport, two-wheeled vehicles, and private cars, even when taking into account the sharp increase in the number of inhabitants in Toulouse in the last few years. The various planning options presented in these scenarios have been discussed, but the general progress of these measures seems to be going towards a decrease of the urban traffic.

Besides, modelling, coordinated by the ORAMIP, of the urban ambiant concentrations of NO_x and PM_{10} is under construction for the more ambitious scenario. It not only takes into account the estimated traffic but also industrial emissions. It will allow translating the various planning options into population exposure to air pollution.

Finally, the last step will be to translate this scenario in terms of health impact assessment.

Toulouse partners

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VALENCIA CITY REPORT

Valencia

Background

Valencia, according to the census of 1996, has 746 683 inhabitants, with 16% of people over 65 years old.

The city is situated on the shores of the Mediterranean sea, without many green areas in the urban area, although it has important zones dedicated to agriculture in the whole area of the municipality (about 40% of the land area).

The climate in the city, given its location, is known as mesothermal (temperate), with mild, humid winters and warm, hot summers. Given the low level of rainfall, it is classified as semiarid. The average mean daily temperature for the period 1995-1999 was 18.68°C, with 14.04°C and 23.32°C the corresponding averages for daily minimum and maximum temperatures. For the same period, the average daily relative humidity was 65% and the atmospheric pressure was 1015 mb.

Sources of air pollution

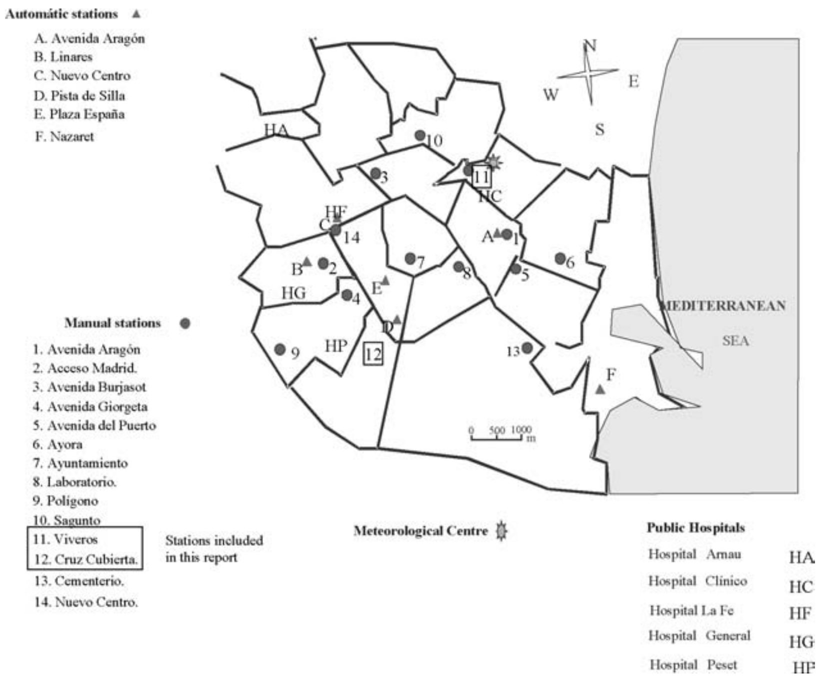
Air pollution in Valencia mainly derives from motor vehicle exhaust emissions, with industrial pollution playing a smaller part. Other potential emissions are combustion from agriculture or food activities (i.e. bakeries). Heating is not a major source in Valencia because of the mild climate during the winter.

Exposure data

Air pollution levels are monitored by the Environmental Laboratory within the Health Division of the Valencia Council. The air pollution monitoring network consists of 14 manual and six automatic monitoring stations. A complete description of type and number of monitoring sites is given in Appendix 3.

From the manual stations we obtained the 24-hour average levels for black smoke (reflectometry method). Most of the stations are located within the urban area of Valencia with medium to heavy traffic. (see map below).

Location of monitoring stations, meteorological centre and hospitals in the city of Valencia



The most recent year for which air pollution measurements were available in Valencia was 1999. Only the data obtained from those stations with valid readings on more than 75% of days were used in this project.

In the context of Health Impact Assessment of the Apheis project, particulates -measured as PM_{10} or black smoke- are included for this report. On the other hand, it is recommended to use data from background stations. Data for PM_{10} in Valencia is only partially available from a monitoring station, and it primarily reflects industrial sources, so we did not include it.

Among the five background stations measuring black smoke, only two (named Viveros and Cruz Cubierta) reported more than 75% valid data for 1999. So we calculated the daily average from these two stations for the purposes of this report.

The number of days for this indicator of black smoke 24-hour levels with valid data was 355 (97.3%).

Average of daily mean levels of black smoke in 1999 in Valencia was 23.5 $\mu g/m^3$ (Standard deviation: 15.6). Percentile 10 was 10.5 $\mu g/m^3$ and percentile 90 was 44.9 $\mu g/m^3$.

153 days exceeded the level of 20 $\mu g/m^3$ of black smoke, and 31 days exceeded the level of 50 $\mu g/m^3$ of black smoke.

Meteorological data were provided by Instituto Nacional de Meteorología from the sampling station at the Meteorological Centre in the park of Viveros.

Health data

The daily number of deaths in Valencia was obtained from the Valencian Community's Mortality Register. The group to be studied was restricted to the city's residents only. Some studies have been published on the completeness of the register and the quality of patient diagnosis showing that the register is both complete and reliable.

For 1999 the daily mean for total mortality (ICD9<800) was 17.3 and Standard Deviation 5.88.

The standardised mortality rate of Valencia using the European population as a reference (IARC 1982) is 700 per 100 000 inhabitants.

The number of emergency daily admissions was obtained from the registry databases of the five hospitals of the public health system in the city. This system uses a standardised procedure to collect hospital admissions in Spain. In the Community of Valencia, roughly all the population is covered by the regional health system, although some people use some private health services. For the diagnoses used in Apheis, it is thought that the coverage represents more than 90% of the admissions in the city. Also, only admissions for residents of Valencia city were selected. The diagnosis used was the one that motivated the admissions reflected in the discharge report.

For 1999:
- daily mean (SD) of respiratory hospital admissions 65 years + (ICD9 460-519) was 5.7 (3.1).
- daily mean (SD) of cardiac hospital admissions all ages (ICD9 410-414, 427, 428) was 7.7 (3.3).

Incidence annual rates for hospital admissions:

- cardiac admissions: 376.4/100 000
- respiratory admissions 65 yearst: 1 725.5/ 100 000.

Data on influenza are provided by the Health Division of the Valencia Council.

Health impact assessment

We consider only the short-term exposure or acute effects scenarios for black smoke since, for the time being, no exposure-response functions are available for the long-term effects of black smoke.

We used three scenarios to estimate the acute effects of short-term exposure to black smoke (BS) on mortality and hospital admissions over one year:

– for a reduction of BS levels on all days above a 24-hour value of 50 μg/m^3 to 50 μg/m^3
– for a reduction of BS levels on all days above a 24-hour value of 20 μg/m^3 to 20 μg/m^3
– for a reduction by 5 μg/m^3 in the annual mean value of BS.

Table 1 presents the attributable number of deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 2 presents the results for hospital admissions.

Table 1. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m^3, above 20 to 20 μg/m^3 and all days by 5 μg/m^3 – Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year					
	Number of days per year exceeding 20 and 50 μg/m^3	No. of deaths central	No. of deaths lower	No. of deaths upper	No. of deaths per 100 000 central	No. of deaths per 100 000 lower	No. of deaths per 100 000 upper
50 μg/m^3	31	4.9	2.5	6.6	0.6	0.3	0.9
20 μg/m^3	153	28.1	14.1	37.4	3.7	1.9	5.0
By 5 μg/m^3	NA*	18.9	11.0	26.7	2.5	1.5	3.6

**NA: not applicable*

Table 2. **Potential benefits of reducing daily black smoke levels above 50 to 50 μg/m^3 and above 20 to 20 μg/m^3. Number of admissions (95% confidence limits) attributable to the acute effects of black smoke**

		Attributable cases per year		
	Number of days per year exceeding 20 and 50 μg/m^3	No. cases central	No. cases lower	No. cases upper
Hospital admissions for cardiac diseases (all ages)				
50 μg/m^3	31	4.0	1.5	6.5
20 μg/m^3	153	22.8	8.3	37.1
Hospital admissions for respiratory diseases (+65)				
50 μg/m^3	31	0.3	0.0	2.4
20 μg/m^3	153	1.5	0.0	13.8

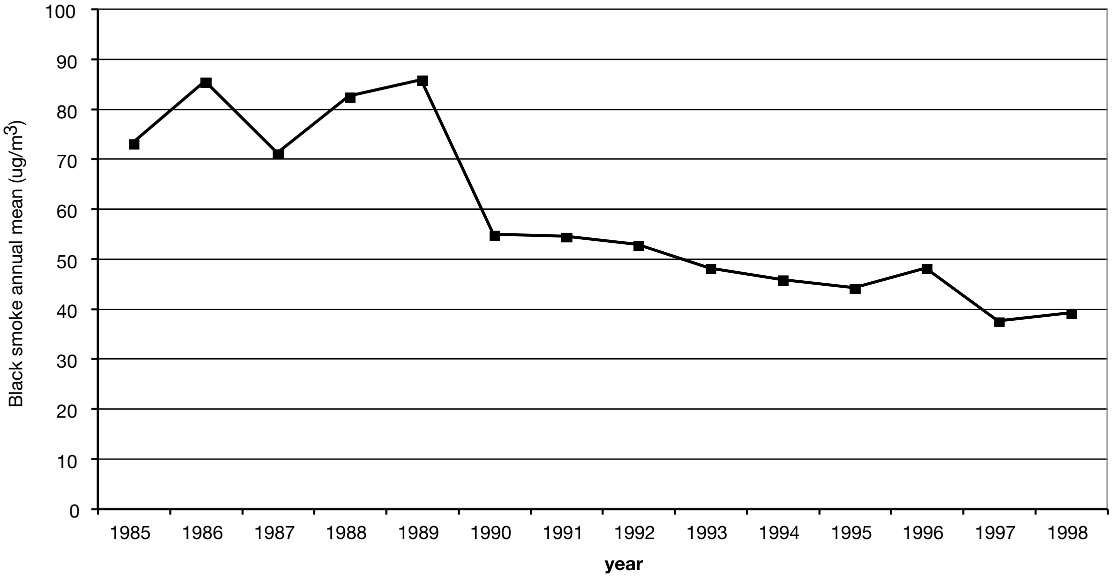
Comments

In 1999, 6 310 people died in Valencia for all causes except external ones. According to the HIA, if the 153 days with daily mean black smoke levels higher than 20μg/m^3 were reduced to 20μg/m^3, the resulting benefit for the short-term effects would be 28 deaths (or 3.7 deaths per 100 000 inhabitants). The corresponding reduction in excess cases for hospital admissions for cardiovascular diseases would be 23 people.

It is important to note that in Valencia, as in other Mediterranean cities, the urban structure is very compact, with people living close to streets with traffic. One of the stations included in this report (Viveros) is located in the major city park and could under-represent the actual levels of population exposure. When interpreting the HIA calculations for Valencia, this factor should be taken into account.

Levels of air pollution in Valencia have changed within the last 15 years. Figure 1 shows the evolution in annual mean concentrations of black smoke in the city of Valencia. Between 1985 and 1998, black smoke concentrations showed a clear decrease (around 50%). The sharpest decrease followed the A-7 motorway by-pass construction around the city in 1990. Other causes for this decrease are the reduction of emissions due to industry and the change to vehicles with a smaller emission of this pollutant.

Figure 1. Annual mean concentrations for black smoke in Valencia, 1985-1998.



Note: the monitoring stations used for calculating annual means in Figure 1 are all those available in Valencia, and not only the two used for HIA in this report.

It is easy to understand that this reduction in the levels of black smoke has had a beneficial impact on the health of the population in Valencia. If air quality in the city had remained stagnant, it would have had a much more negative impact on the health of the population. However this decrease must not lead us to think that the situation could be better. The higher the levels, the more benefits for health. On the other hand, there are other pollutants, such as NO_2, PM_{10} or ozone, that should be considered in further evaluations.

Epidemiological research assessing the impact of air pollution on health has been conducted in Valencia since 1994. In 1997, a national multi-centre study on the air pollution levels and health impacts was set up in 14 Spanish cities (named the EMECAS project). The co-ordinating centre for this project is the same as for Apheis in Valencia (EVES). Up to now, this project has provided estimates for the impact of air pollution on mortality in Spain. Nowadays, data from emergency hospital admissions and more recent data on mortality have been analysed as part of the EMECAS project.

Valencia partners

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