STRASBOURG CITY REPORT

Daniel Elstein

French Institute of Public Health Surveillance

Strasbourg

France

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Summary of the main findings

Air pollution levels and trends compared to EC limit values : for the entire year, PM10 daily levels mean were respectively, in 1999 and 2002, 22.3 and 23 µg/m^3 which is under the 2005 limit value but over the 2010 limit value. In 2002, PM2.5 daily levels mean was 16 µg/m^3.

The analysis estimated that reduction of the long-term PM pollution to the levels of PM2.5 of 15 ug/m3 would reduce mortality in Strasbourg by 54 deaths in one year, which would save 26 years of expected life for starting year of simulation. If the daily means of PM10 would be kept under 20 ug/m^3, 11 deaths and 33 hospital admissions could have been avoided in the year 2002.

Main causes of air pollution in the city, and actions implemented / planned to reduce it: the most important cause of air pollution in Strasbourg is the road transport and particularly car transport. Since many years, efforts are made in the way of reducing traffic in the town centre.

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 among 27 communities, over 304 km^2, and a density of 1 484 hab./km^2.
The area 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 of 6.5 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 plan of circulation for the city centre, tramway, better public transport, new footpassenger spaces, cycling tracks, green spaces, etc…).

The Regional Plan for Air Quality (PRQA) was definitively approved in December 2000. It takes stock of the air quality situation, emissions sources, the various actions that have been taken locally and lists the various guidelines which aim to improve air quality surveillance, the guidelines on emission controls and on information to the public. Alsatian decision-makers are relatively concerned about environmental issues. In Strasbourg, many measures have been taken to improve air quality, such as the new traffic management for the city centre, the creation of a tramway, enhancement of the public traffic network, new pedestrian areas, cycle tracks, green areas, etc. There is a substantial involvement of the regional Council in response to a concern from the local population. As such, the *Alsace Nature* Association is highly involved in any meetings relating to environment and is very active in all discussions (emissions from the airport, ionizing radiations, etc.). The Bas-Rhin Regional Council has set up controls against the greenhouse effect. The C.U.S. and Regional Council have initiated in 1996 O_3 plans in order to reduce pollution levels when they exceed the recommended levels

of pollution. In May 2001, the first meeting of the PRQA follow-up committee took place. The role of this committee is to coordinate the follow-up of the PRQA guidelines, to inform and to make the general public aware of its responsibilities, to encourage actions to improve air quality. The committee is divided into several working groups from various PRQA working groups with issues on “Information and communication”, “Energy”, “Air quality monitoring”, “Mobile sources” and “Health effects”.
Referring to the numbers of inhabitants in Strasbourg (more than 250 000), a Plan for Air Protection (PPA) has been elaborated by the Prefect in 2001. The objective, according with the PRQA, is to reduce Air Pollution to a concentration under levels defined by European Policy and to elaborate alert procedures.

Objectives of Apheis 3 at the local level, is to realize a Health Impact Assessment (HIA) for PM10, according with different scenarios in decreasing of air pollution. This objective complete PSAS-9 HIA in Strasbourg which were realized for other pollutants than PM.

Sources

Principal sources of air pollution were described in detail in the previous Apheis city report last year (www.apheis.org). This is an update of the main sources of air pollution:

In 1997 : SO_2 emissions are mainly produced by industries (70%) and to a lesser extent from residential/third sector (24). Particle sources are divided more homogeneously among the 3 types of polluters: 40 % for residential/third sector, 26 % for industries and 34 % for traffic. Particle emissions in small heating equipments are mainly due to wood (97%). NOx emissions are mainly due to traffic (65%) but also to industries (25%) and to residential/third sector (10%). Non methanic volatile organic compounds were produced by industries (38%), traffic (25%) and residential/third sector (15%). More specifically, Benzene emissions are due mainly to traffic (75%). CO emissions are mainly due to residential/third sector and traffic (43% and 55% respectively in 1997). (Sources : CITEPA, 1997 ; LPCA – Plan de Protection Atmosphérique Strasbourg/Kehl, 1990)

In 2000 (ASPA: Emissions de polluants sur la zone du Plan de Protection de l’Atmosphère de Strasbourg; March 2003):

- Road/ heating/industry/others

Source (2000)	Energy production and distribution	Industry	Heating	Waste Management	Road Transport	Not Road Transport	Agriculture
SO_2	74 %	9 %	13 %	-	-	-	-
NOx	17 %	-	8 %	6 %	58 %	-	-
NH_3	-	-	-	5 %	25 %	-	68 %
HCl	57 %	14 %	9 %	19 %	-	-	-
HF	17 %	7 %	-	71 %	-	-	-
CO	-	-	10 %	-	86 %	-	-
COVNM	10 %	35 %	11 %	-	38 %	-	-
PM10	32 %	13 %	5 %	-	43 %	-	-

PM2.5	34 %	-	5 %	-	49 %	-	-
CO_2	21 %	9 %	31 %	10 %	27 %	-	-
CH_4	54 %	-	14 %	-	10 %	-	18 %
N_2O	29 %	-	10 %	10 %	23 %	-	23 %
C_6H_6	-	-	-	-	91 %	-	-
BaP	-	22 %	70 %	-	-	-	-
PCDD/F	-	-	-	96 %	-	-	-
Pb	6 %	11 %	-	81 %	-	-	-
Cd	15 %	6 %	-	74 %	-	-	-
As	27 %	56 %	10 %	7 %	-	-	-
Ni	87 %	8 %	-	-	-	-	-
Hg	5 %	-	-	90 %	-	-	-
Cr	79 %	-	-	10 %	5 %	-	-
Cu	10 %	-	-	26 %	54 %	8 %	8 %
Se	76 %	21 %	-	-	-	-	-
V	39 %	-	61 %	-	-	-	-
Zn	-	-	-	69 %	17 %	-	-

-: < 5 % Emissions

Principal industrial sources of air pollution are localized in the North of Strasbourg, for SO_2 and the major part of the pollutants associated with combustion, in the West of the zone for Volatil Organic Compound (VOC/COV) and NO_XThe principal sources are Transport for CO, VOC, NO_X and particulates, Industry for SO2, NO_X, VOC.

- PM 10 composition : Pb (0.07 µg/m^3), Cd (< 1.00 ng/m^3), As (weak concentrations), Ni (10 ng/m^3),

Exposure data

Stations and method of measure

Black Smokes are not measured in Strasbourg.

PM10 were measured by 3 urban background stations, since 30/09/99: Strasbourg Centre, Strasbourg Est and Strasbourg Nord.
PM2.5 were measured by 2 urban background stations: Strasbourg Centre since 16/07/01 and Strasbourg Est since 08/01/01..
PM10 and PM2.5, as usual, are measured by the method of TEOM.

Corrections factors

- Use of correction factor for automatic measurements of PM10: **1.215** during winter, **1.000** during summer.
- Use of conversion factor from PM10 to PM2.5: **0.7**

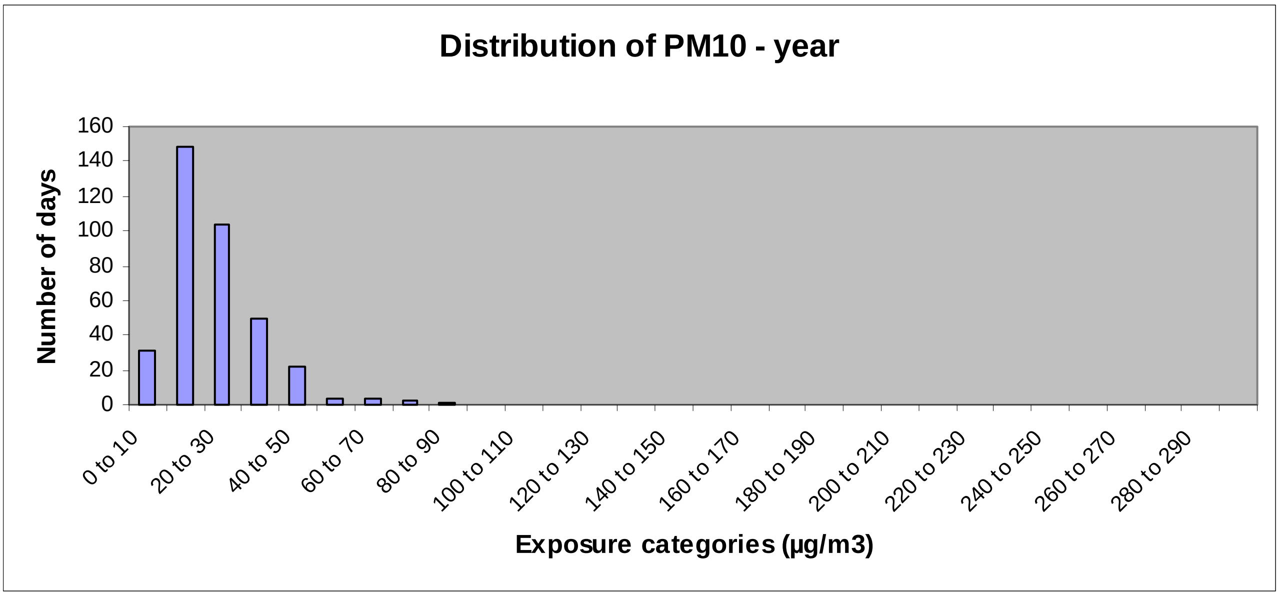
Exposure data for Apheis 3:

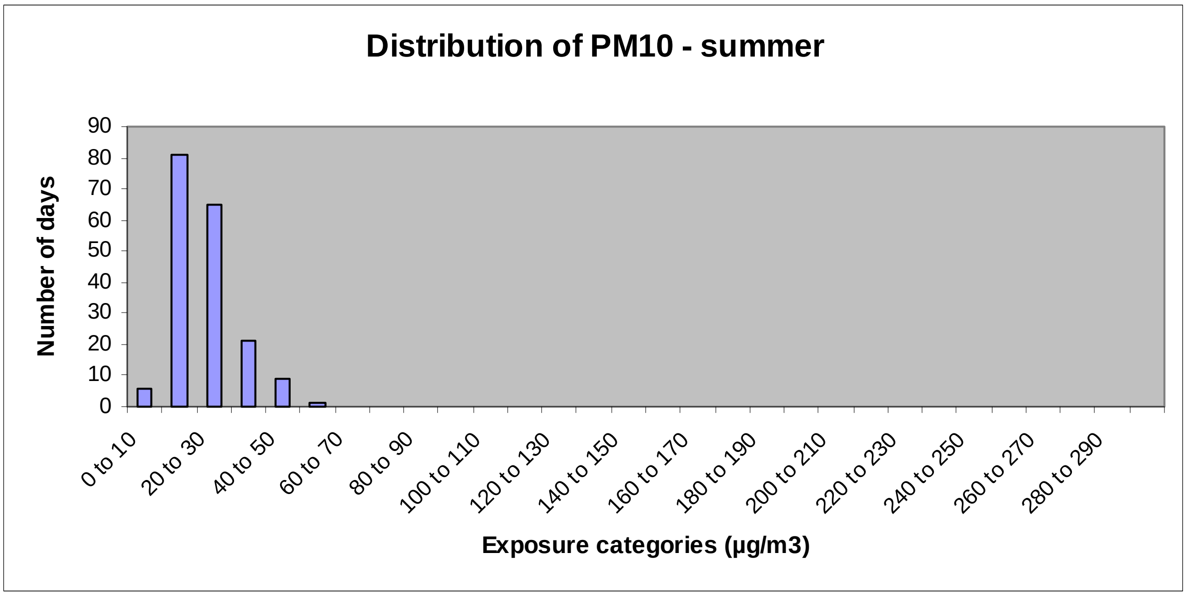
- Year of air pollution data : 2002
- Daily mean levels (SD) of PM10 and PM2.5, for the entire year were, respectively 23,0 µg/m^3 (12,0 µg/m^3) and 16,0 µg/m^3 (10,0 µg/m^3).
- The levels of PM10 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 9 µg/m^3 and 46 µg/m^3. The levels of PM2.5 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 6 µg/m^3 and 34 µg/m^3.
- Number of days when air pollutants exceeded limit levels:

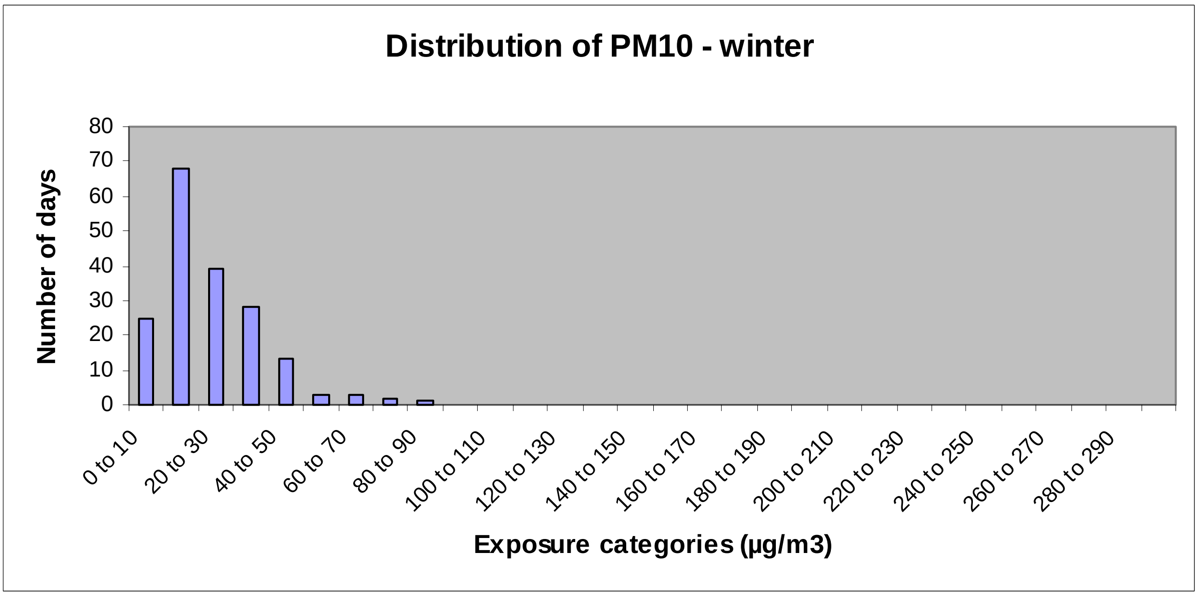
Table 2. Number of days when air pollutants exceeded limit levels

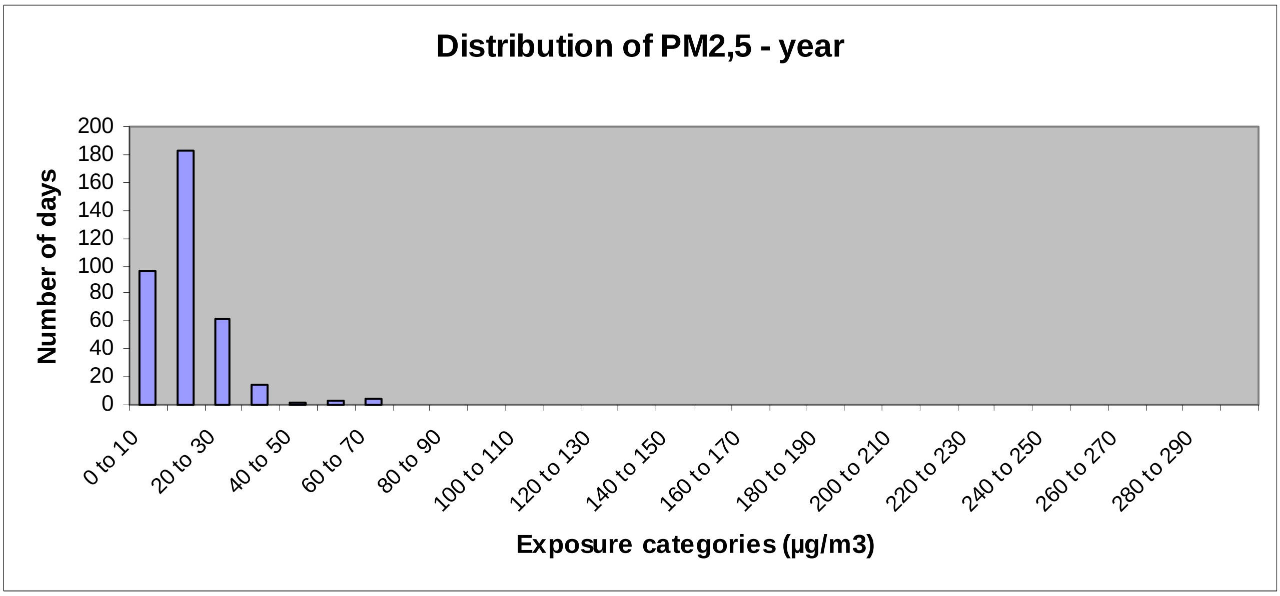
	Short term		
Air pollutant	**PM_{10}**	**BS**	**$PM_{2.5}$**
Number of days above	20 µg/m^3	20 µg/m^3	14 µg/m^3
	185		168
Number of days above	50 µg/m^3	50 µg/m^3	35 µg/m^3
	10		18

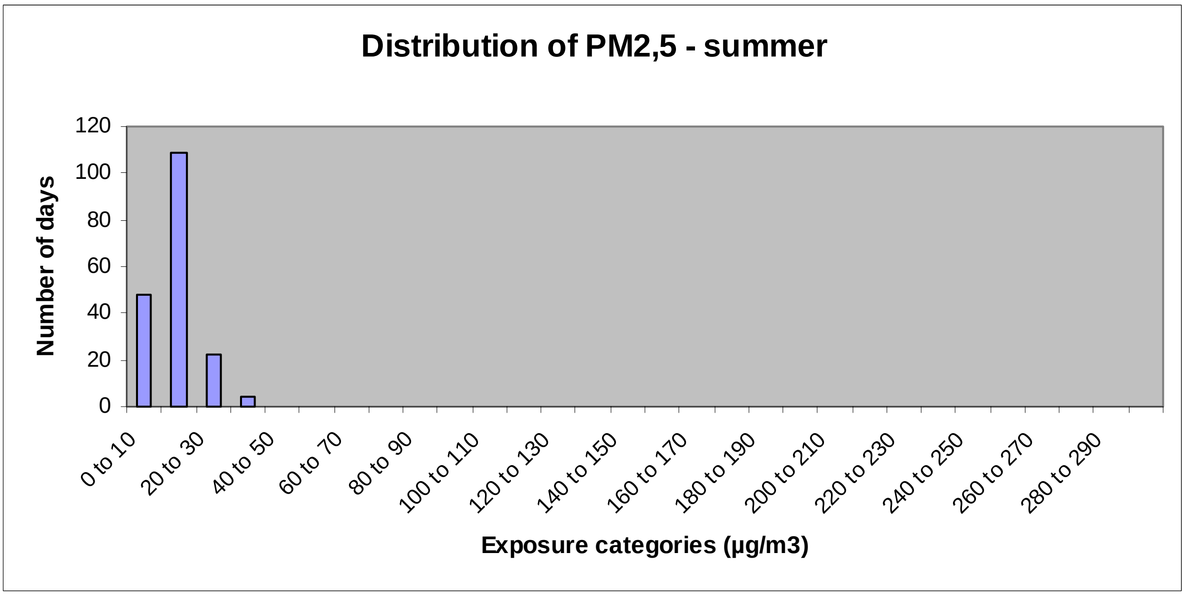
The six following figures show the distribution of days of year, summer and winter based on the levels of PM10 (3 first figures) and PM2.5 (3 last figures). Il all the cases, the number of days is maximum for 20 to 30 µg/m^3.

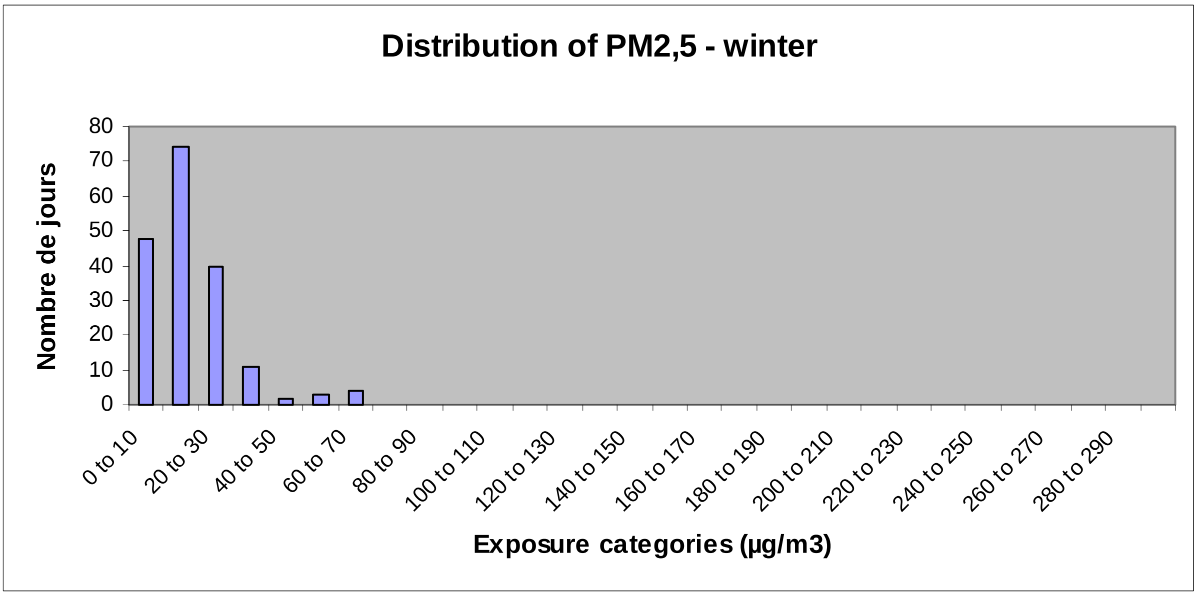



Distribution of PM10 - summer
Number of days
0
10
20
30
40
50
60
70
80
90
0 to 10
20 to 30
40 to 50
60 to 70
80 to 90
100 to 110
120 to 130
140 to 150
160 to 170
180 to 190
200 to 210
220 to 230
240 to 250
260 to 270
280 to 290
Exposure categories (µg/m3)


Distribution of PM10 - winter
Number of days
0
10
20
30
40
50
60
70
80
0 to 10
20 to 30
40 to 50
60 to 70
80 to 90
100 to 110
120 to 130
140 to 150
160 to 170
180 to 190
200 to 210
220 to 230
240 to 250
260 to 270
280 to 290
Exposure categories (µg/m3)


Distribution of PM2,5 - year
Number of days
0
20
40
60
80
100
120
140
160
180
200
0 to 10
20 to 30
40 to 50
60 to 70
80 to 90
100 to 110
120 to 130
140 to 150
160 to 170
180 to 190
200 to 210
220 to 230
240 to 250
260 to 270
280 to 290
Exposure categories (µg/m3)





Note : after corrections for PM10 and conversion for PM2.5, daily mean levels (SD) of PM10 and PM2.5, for the entire year were, respectively 25,0 µg/m^3 (14,0 µg/m^3) and 18,0 µg/m^3 (10,0 µg/m^3).The levels of PM10 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 11 µg/m^3 and 50 µg/m^3. The levels of PM2.5 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 8 µg/m^3 and 35 µg/m^3.

Health data

- Mortality data (1999), based on the 9th International Classification of Diseases (CIM9), were available from the Centre of Epidemiology about the medical Causes of

Deaths (CépiDC) at the French National Institute of Health and Medical Research (INSERM). The more recent available data for long term HIA were for year 1999.
- For hospital Admission, data (2000) concerned public hospitals and were extracted from the French Hospital Information System (PMSI) by the Hospital Information technical Agency (ATIH).
- Age-standardised total mortality rate, using Total European Population as a reference is 736 per 100 000 inhabitants for year 2000 [1].

Table 3. Daily mean number and annual rate per 100 000 of deaths and hospital admissions (2000)

Health outcome	**ICD9**	**ICD10**	**Daily mean number (SD)**	**Annual number of cases per 100 000** / daily mean per 100 000
Short term HIA				
All causes mortality (excluding external causes)*	< 800	A00-R99	**9 (3)**	**693.4** / 1.9
Cardiovascular mortality	390-459	I00-I99	**3 (2)**	**230.3** / 0.6
Respiratory mortality	460-519	J00-J99	**1 (1)**	**65.4** / 0.2
Cardiac hospital admissions	390-429	I00-I52	**9**	**736.4** / 2.0
Respiratory hospital admissions	460-519	J00-J99	**9**	**721.3** / 2.0
Long term HIA				
All causes mortality	0-999	A00-Y98	**9**	**735,7** / 2.0
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	**3**	**278.0** / 0.8
Lung cancer mortality	162	C33-C34	**1**	**43,9** / 0.1

* For short and long term scenarios

Health impact assessment

Different scenarios were used to evaluate short and long-term exposure to particulate pollution. In the city of Strasbourg, these scenarios were built for two indicators of this particulate pollution: PM10 and PM2.5. The estimated health impacts of these indicators may overlap, and caution is recommended in the interpretation of findings: under no circumstances should we add findings of these indicators because they represent the same type of pollution.

Different tools and different estimates were used to evaluate the short- and long-term impacts of this particulate pollution on health. (Table 4).

[1] UNITED NATIONS. Population Division Department of Economic and Social Affairs. World Population Prospects: The 2000 Revision.

Table 4. Summary SHORT-TERM Health impact assessment (HIA)					
	Health indicator	**ICD**		**Tool**	**RR (95% IC)** For 10 µg/m^3 increase
Attributable cases		**ICD9**	**ICD10**		
		ST HIA for all cities report			
PM10	All ages, all causes mortality (excluding external causes) All ages, cardiovascular mortality All ages, respiratory mortality All ages, cardiac hospital admissions All ages, respiratory hospital admissions	< 800 390-459 460-519 390-429 460-519	A00-R99 I00-I99 J00-J99 I00-I52 J00-J99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.008) WHO, 2003: 1.009 (1.005 - 1.013) WHO, 2003: 1.013 (1.005 - 1.021) Le Tertre et al. 2002: 1.006 (1.003 - 1.009) Apheis 3: 1.0114 (1.0062 - 1.0167)
BS	All ages, all causes mortality (excluding external causes) All ages, cardiovascular mortality All ages, respiratory mortality All ages, cardiac hospital admissions All ages, respiratory hospital admissions	< 800 390-459 460-519 390-429 460-519	A00-R99 I00-I99 J00-J99 I00-I52 J00-J99	French PSAS-9 Excel spreadsheet	WHO, 2003: 1.006 (1.004 - 1.009) WHO, 2003: 1.004 (1.002 - 1.007) WHO, 2003: 1.006 (0.998 - 1.015) Le Tertre etal. 2002:1.011 (1.004 - 1.019) Apheis 3: 1.0030 (0.9985 -1.0075)
PM10 Distributed lag (40 days)	All ages, all causes mortality (excluding external causes) All ages, cardiovascular mortality All ages, respiratory mortality	< 800 390-459 460-519	A00-R99 I00-I99 J00-J99	French PSAS-9 Excel spreadsheet	Zanobetti et al. 2002: 1.01227 (1.0081 - 1.0164) Zanobetti et al. 2003: 1.01969 (1.0139 - 1.0255) Zanobetti et al. 2003: 1.04206 (1.0109 - 1.0742)
		Complementary ST HIA for some cities reports			
PM10 with shrunken stimates	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Apheis 3: RRs and 95% CI of the shrunken estimate for each city
					RR
				Athens	1,012 (1,008-1,017)
				Barcelona	1,009 (1,005-1,012)
				Budapest	1,005 (0,999-1,011)
				Cracow	1,004 (0,998-1,009)
				London	1,007 (1,004-1,010)
				Madrid	1,006 (1,002-1,010)
				Paris	1,005 (1,001-1,009)
				Rome	1,011(1,006-1,015)
				Stockholm	1,006 (0,999-1,013)
				Tel-Aviv	1,006 (1,002-1,011)

Table 4 (cont), Summary LONG-TERM Health impact assessment (HIA)						
	Health indicator	ICD 9	ICD10	Tool	RR (95% IC) For 10 µg/m^3 increase	Scenarios
Long term HIA for all-cities report						
Attributable cases						**Annual mean**
PM10	All causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Kunzli et al, 2000 1.043 (1.026 -1.061)	Reduction to 40 µg/m^3 Reduction to 20 µg/m^3 Reduction by 5 µg/m^3
PM2.5	All causes mortality Cardiopulmonary mortality LCA	0-999 401-440 and 460-519 162	A00-Y98 I10-I70 and J00-J99 C33-C34	French PSAS-9 Excel spreadsheet	CA III Pope, 2002 1.06 (1.02 - 1.11) 1.09 (1.03 - 1.16) 1.14 (1.04 - 1.23)	Reduction to 20 µg/m^3 Reduction to 15 µg/m^3 Reduction by 3.5 µg/m^3
YoLL						**Annual mean**
PM2.5	All causes mortality Cardiopulmonary mortality LCA	0-999 401-440 and 460-519 162	A00-Y98 I10-I70 and J00-J99 C33-C34	WHO AirQ software	CA III Pope, 2002 1.06 (1.02 - 1.11) 1.09 (1.03 - 1.16) 1.14 (1.04 - 1.23)	Reduction to 20 µg/m^3 Reduction to 15 µg/m^3 Reduction by 3.5 µg/m^3
Complementary LT HIA for some cities report						
Prospective scenarios on air pollution, prospective scenarios on birth numbers	Local choice	–	–	WHO AirQ software	–	–

Also different approaches were used to describe the impacts:
For PM10, short and long-term findings are expressed in terms of number of attributed deaths per year
For PM2.5, long-term findings are expressed in terms of:

- number of attributed deaths per year
- number of expected years of life lost for starting year of simulation.

Short-term scenarios

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

Short term HIA scenarios for BS

We used three scenarios to estimate the acute health effects of BS on all causes (excluding external causes), cardiovascular and respiratory mortality over one year:

- reduction of BS levels to a 24-hour value of 50 $\mu g/m^3$ on all days exceeding this value
- reduction of BS levels to a 24-hour value of 20 $\mu g/m^3$ on all days exceeding this value
- reduction by 5 $\mu g/m^3$ of all the 24-hour values of BS.

Short term HIA scenarios for PM10

- **Short-term HIA of PM_{10} on 0-1 days and cumulative HIA of PM_{10} up to 40 days**

We used three scenarios to estimate the acute health effects of PM_{10} on 0-1 days and cumulative health effects of PM_{10} up to 40 days on all causes (excluding external causes), cardiovascular and respiratory mortality over one year:

- reduction of PM_{10} levels to a 24-hour value of 50 $\mu g/m^3$ on all days exceeding this value (2005 and 2010 limit values for PM_{10})
- reduction of PM_{10} levels to a 24-hour value of 20 $\mu g/m^3$ on all days exceeding this value (to allow for cities with low levels of PM_{10})
- reduction by 5 $\mu g/m^3$ of all the 24-hour values (to allow for cities with low levels of PM_{10})

- **Combined local and meta-analytic estimates for short-term HIA of PM10**

We used the same scenarios than above and combined local and meta-analytic estimates to calculate the acute health effects of PM_{10} on all causes of death (excluding external causes) over one year. This sensitivity analysis was done to study the interest of including the weight of a local estimates in the combined (meta-analytic) one.

Long-term scenarios

Long-term HIA scenarios for PM10

We used three scenarios to estimate the chronic effects of long-term exposure to PM_{10} on all causes mortality (excluding external causes) over one year:

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

Long term HIA for PM2.5

We estimated chronic effects of $PM_{2.5}$ in Strasbourg in population over 30 years old as impacts on mortality due to all causes, due to cardiopulmonary and due to lung cancer deaths.

The following three pollution scenarios were considered:
- reduction of the annual mean value of $PM_{2.5}$ to a level of 20 µg/m^3 [2]
- reduction of the annual mean value of $PM_{2.5}$ to a level of 15 µg/m^3 [2]
- reduction by 3.5 µg/m^3 in the annual mean value of $PM_{2.5}$ (to allow for cities with low levels of $PM_{2.5}$)

BS findings

BS are not measured in Strasbourg.

PM10 findings

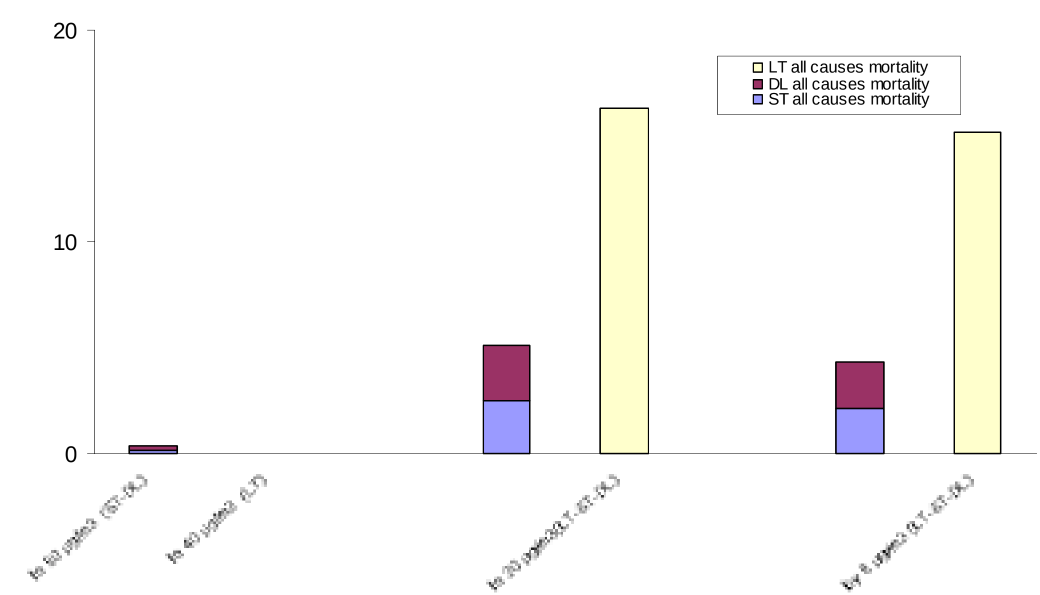
1. Short-term HIA of PM10 on 0-1 days and cumulative HIA of PM10 up to 40 days, and long term HIA of PM10

All tables are in appendix.

1.1. Mortality findings

The following graphs show the health impact of PM10 on mortality for different lags: short-term-ST (0-1 day lag), cumulative effect –DL-distributed lag (up to 40 days lag) and long-term LT (years).

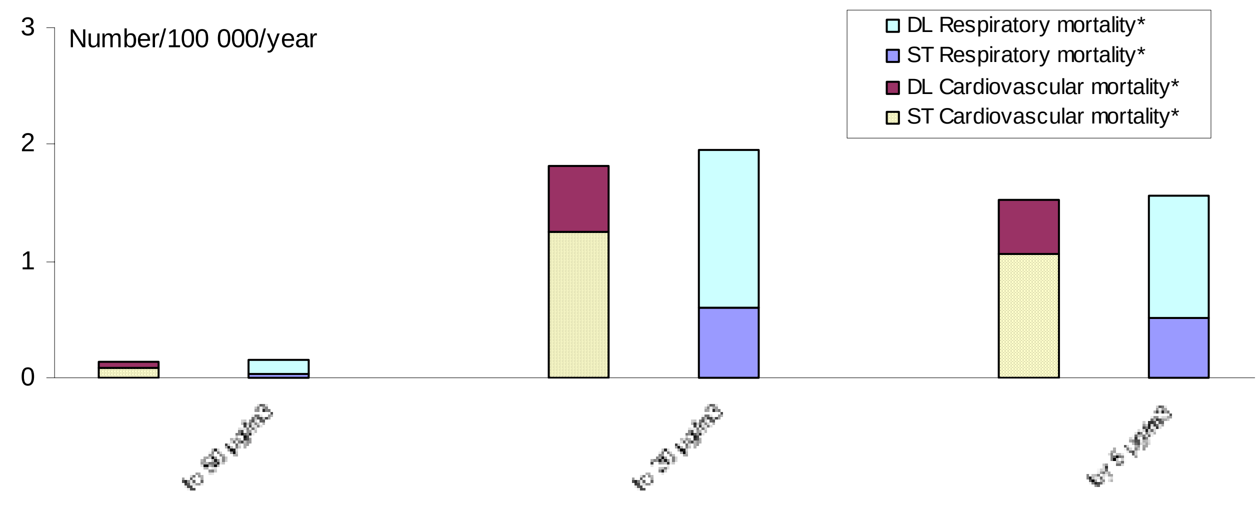
Figure 4. PM10: reductions to 50/40-20-by 5 µg/m3. Short term (ST), cumulative (DL), long term (LT) health impact on all causes mortality (ICD 9 <800)



* PM10 data for 2000, mortality data for 2000

Long term effect of air pollution on mortality (fig 4) is near thrice the cumulative effect which is twice the short term effect.

Figure 5. PM_{10}: reductions to 50-20-by 5 µg/m3. Short term (ST), cumulative (DL) health impact on specific mortality



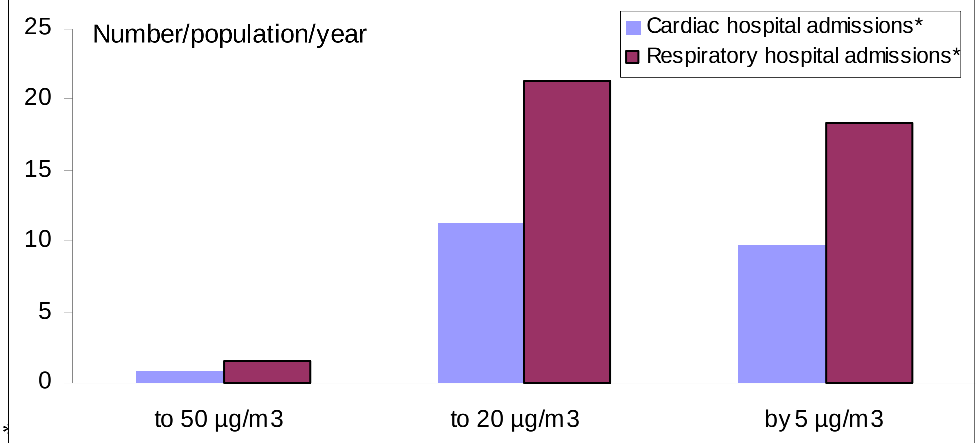
*Cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519).
** PM10 data for 2002, mortality data for 1999

For respiratory mortality (fig 5), one observes that cumulative term effects of exposure are twice the acute effects. For cardiovascular mortality, there is less difference between the two effects.

1.2. Hospital admissions findings

We estimated the acute effects of short-term exposure to PM_{10} on cardiac and respiratory hospital admissions over one year.

Figure 6. PM_{10} : reductions to 50-20-by 5 µg/m^3.
Short-term health impact on hospital admissions



The numbers of respiratory admissions attributable to air pollution are twice the cardiovascular admissions.

2. Combined local and meta-analytic estimates for the health effects of PM_{10}

Combined local and meta-analytic estimates were non applied to Strasbourg.

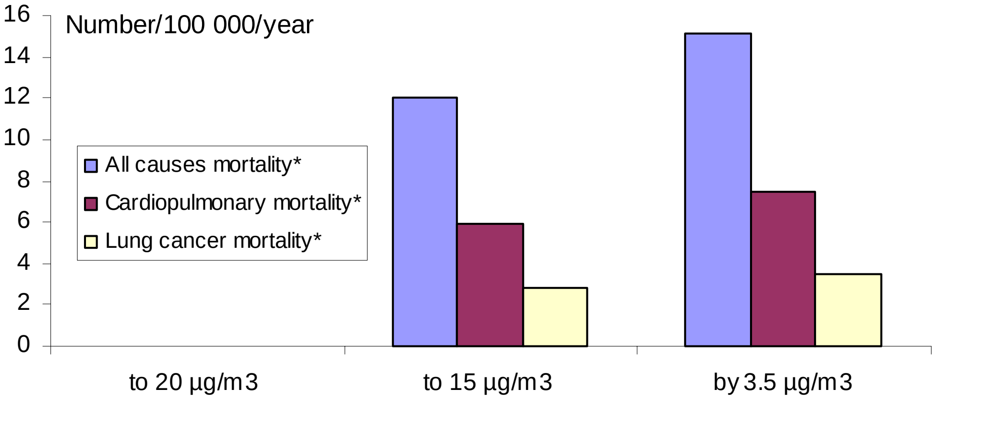
PM2.5 findings

1. Number of attributed cases

We also used three scenarios to estimate the chronic effects of long-term exposure to $PM_{2.5}$ on mortality over one year.

The following graph presents the attributable number of all causes, cardiopulmonary and lung cancer deaths expressed as per 100 000 inhabitants.

Figure 8. $PM_{2.5}$: reductions to 20-15-by 3.5 µg/m^3. Long-term health impact on total and specific mortality



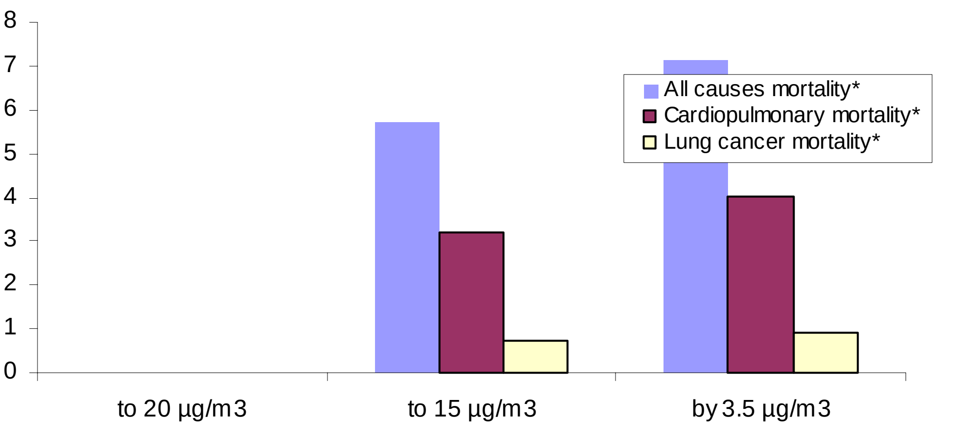
* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162).
** PM2.5 data for 2000, mortality data for 2000

The effects on cardiopulmonary mortality attributable to air pollution are twice the effects on lung cancer mortality. The sum of cardiopulmonary and lung cancer deaths is 70 % of total number of death.

2. Years of life lost

We estimated the years of life lost attributable to the chronic effects of $PM_{2.5}$ using the data for 2002
Figure 9 presents the years of life lost for all causes, cardiopulmonary and lung cancer deaths for 30 years of age or older in the population of Strasbourg.

Figure 9. $PM_{2.5}$: reductions to 20-15-by 3.5 µg/m^3. Expected years of life lost for the first year of simulation for total and specific mortality for >30 years old



* All causes mortality (ICD9 0-999), cardiopulmonary mortality (ICD9 401-440 and 460-519), lung cancer mortality (ICD9 162).
** PM2.5 data for 2002, mortality data for 1999

For all causes of deaths, all other things being equal, reduction of $PM_{2.5}$ by 3.5 µg/m^3 in 2002 would save almost 32 years of expected life for starting year of simulation in people older than 30 years in the city of Strasbourg. For cardiopulmonary mortality, this number would be around 18 and for lung cancer mortality, more than 4.

The following table presents the findings in terms of life expectancy.

Table 5. Life expectancy and its possible increase by reduction of air pollution to 15 ug/m3 in Strasbourg

		Expected gain in life expectancy		
Age	Life expectancy	Mean	Low estimate	High estimate
At birth	78.97	0.17	0.04	0.29
30	49.92	0.17	0.04	0.29
65	18.69	0.13	0.03	0.22

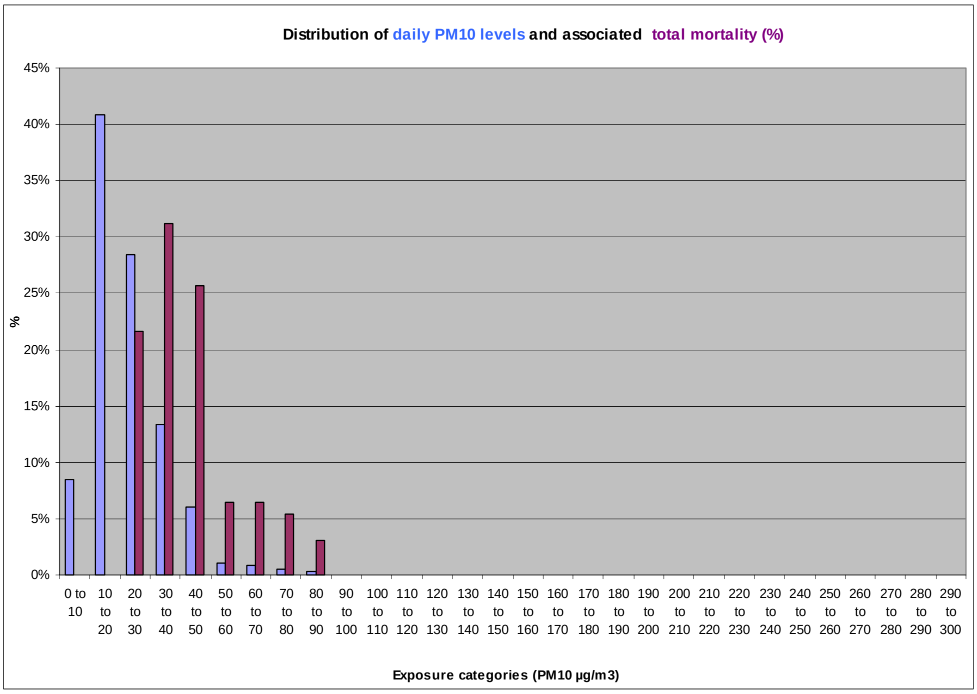
In terms of life expectancy, all other things being equal, if annual mean PM2.5 levels (31 µg/m^3) would be reduced to 15 µg/m^3, the 50 years of life expectancy in a person of 30 years old would be increased by 0.17 years, due to reduced risk of death from all causes in the city of Strasbourg.

Interpretation of findings

For classical pollutants, exposure assessment is now correctly made. There are few lacks in the measures. Concerning the health outcomes, the quality of the admissions indicator is now improved by a review of the selections of ICD codes used for the choice of studied diseases.

Concerning PM10, long term effect of air pollution on total mortality is three times greater than the cumulative effect which is twice the short term effect. For respiratory mortality, the cumulative term effects of exposure are twice the acute effects but for cardiovascular mortality the two effects are close together.
For PM2.5, the effects on cardiopulmonary mortality are twice those on lung cancer mortality. Respectively, for all causes of deaths, for cardiopulmonary mortality and for lung cancer mortality, a reduction of $PM_{2.5}$ by 3.5 µg/m^3 would save almost 32, 18 and 4 years of expected life for starting year of simulation in people older than 30 years in the city of Strasbourg.
In terms of life expectancy, if annual mean PM2.5 levels (31 µg/m^3) would be reduced to 15 µg/m^3, the 50 years of life expectancy in a person of 30 years old would be increased by 0.17 years, due to reduced risk of death from all causes in the city of Strasbourg.
As one can see in the next figure and if it was necessary to insist, air pollution peaks during a few days are of very little importance, compared to daily exposure to lower levels of air pollution over longer periods.

Short term distribution of PM10 levels and associated percentage of cases



General comments

The general council and regional council ask for the creation of a reference bank on bibliographic data relating to the effects of air quality, a list of the studies conducted on the effects of air quality, an inventory of ongoing studies and working groups, and their contact information, as well as to be better informed to support them in decision making.

The accredited association for local air quality monitoring (AASQUA - or local equivalent ASPA) wishes to continue spatial, diagnostic and prediction analysis in relation with the impact on health and environment and encourage studies that aim to assessing the average individual exposure (time activity pattern). Consultants (most of them Chest specialists) wish to have a health and scientific monitoring system of biological and chemical indoor pollutants. They are in favour of encouraging any initiatives to improve knowledge on long-term effects of air pollution on health. The regional direction for health and welfare (DRASS) asks to be trained in health impact assessment. The regional direction for industry, research and environment says to lack risk scales in order to assess the importance of environmental risks in comparison with the risks encountered in everyday life.

Generally speaking, decision-makers ask for decision-making tools, yet the AASQUA and doctors are the partners who show the most interest.

Information is provided to all the partners (decision-makers, AASQUA, GPs (idem) , local technical committee of the air and health monitoring programme, etc.) during various

meetings such as the PRQA follow-up meetings or the plan for Air quality protection and conferences, organized by the Association for the prevention of air pollution, among others.
It seems that, although they do ask for the information provided by the centre of Strasbourg (or by other facilities such as hospitals), decision-makers do not know how to use it in practice. They see technical reports on air and health as too complex and substantial to be able to use them. Besides, they do not automatically take into account the issue on health and environment.
The information is usually broadcast from time to time when scientific results are produced via an official press release or press conference. Beside these events, reports, such as the PRQA report, quote results of epidemiological and clinical studies.

Conclusions

APHEIS surveillance program is useful for air pollution reduction policy in Strasbourg. PSAS-9 program has already been worked in the same direction : HIA has been realised for global exposure (i.e. PM, O_3, NO_2, SO_2). The interest in APHEA system is the European level of the assessment. It is useful, indeed, to compare, for air exposure, the trends of the different health impact in Europe. Nevertheless, PSAS-9 HIA has an big advantage in France in the fact that the risk assessment is estimate by and for the French cities. It seems that it is necessary to find an arrangement of the two system. Furthermore, it is important to provide a correct communication mean in order to give to the population (patients and healthy persons) and the deciders an articulate information. For that, it will be necessary to develop the appropriate templates.

Appendix

1. Questionnaires on the exposure measurement methods and health data

1.1. Questionnaire on exposure measurement methods

Harmonised compilation of information indicating the exposure relevant area of the city, number of PM10, PM2.5 or BS monitoring sites, and the type, sampling and measurement characteristics of stations selected for the HIA of APHEIS

1.	City:	Strasbourg
2.	Total area of agglomeration (km²):	304
3.	Area (km²) covered by the air monitoring network in the city:	304
4.	Number of population in this (exposure relevant) area:	451 133
5.	Total number of PM10 monitoring stations in this area:	5
6.	Total number of BS monitoring stations in this area:	0
7.	**Total number of PM2.5 monitoring stations in this area:**	**3**
8.	Number of selected PM10 monitoring stations for HIA:	3
9.	Number of selected BS monitoring stations for HIA:	0
10.	**Number of selected PM2.5 monitoring stations for HIA:**	**2**

11. Measurement interval (please cross)

continuous x (aggrégées par ¼ h) hourly 24 hours weekly 2 weekly

12. Quality assurance and control (please cross)

yes x (ISO 9002) no do not know

13. Data quality (please cross)

validated data x invalidated data

14. Name, classification and sampling characteristics of the monitoring site (traffic, kerbside, building line, commercial, urban residential, sub-urban, rural, industrial, others)

Name	PM10/BS/PM2.5	Classification
Strasbourg Centre	PM10	urban residential
Strasbourg Nord	PM10	urban residential
Strasbourg Est	PM10	urban residential
Strasbourg Centre	PM2.5	urban residential
Strasbourg Est	PM2.5	urban residential

15. Measurement method / Type of instrument

BS: ____

PM10 manual:____
automated: TEOM (microbalance)
probe temperature (in °C):50°C
optical:____

PM2.5 manual:____
automated: TEOM (microbalance)**_____________**
probe temperature (in °C):____________________
optical:____

16. Using PM10 data for your city HIA calculation, did you used a conversion factor in order to compensate losses of volatile particulate matter?

no

yes X if yes, a) which factor: __1.215_(winter), 1.000 (summer)____________

b) is it a default factor? yes no X

or c) derived from own parallel measurements (reference method vs. TEOM or beta attenuation) yes no

17. If your PM2.5 data have been calculated from your PM10 data, what conversion

factor did you use? factor:__________________**0.7**__________

1.2. Questionnaire on health data

STRASBOURG

CODES PMSI zone Géographique Strasbourg

code postal bureau distributeur 2000	libellé bureau distributeur	code pmsi 2000
67000	STRASBOURG	67000
67100	STRASBOURG	67000
67200	STRASBOURG	67000
67114	ESCHAU	67114
67115	PLOBSHEIM	67115
67116	MUNDOLSHEIM	67116
67118	GEISPOLSHEIM	67118
67201	STRASBOURG	67201
67202	STRASBOURG	67202
67203	STRASBOURG	67203
67205	STRASBOURG	67205
67206	STRASBOURG	67206
67207	STRASBOURG	67207
67300	SCHILTIGHEIM	67300
67380	LINGOLSHEIM	67380
67400	ILLKIRCH GRAFFENSTADEN	67400
67450	MUNDOLSHEIM	67450
67460	MUNDOLSHEIM	67460
67540	OSTWALD	67540
67550	MUNDOLSHEIM	67550
67610	LA WANTZENAU	67610
67640	FEGERSHEIM	67640
67800	BISCHHEIM	67800
67810	HOLTZHEIM	67810
67960	ENTZHEIM	67960

FINESS ETABLISSEMENTS

Numéros FINESS des établissements publics

Hôpitaux	N° FINESS entité juridique	N° FINESS établissements
CHU DE STRASBOURG / HOPITAL CIVIL	67 078 005 5	67 000 002 5
CHU STRASBOURG / HOP HAUTEPIERRE	67 078 005 5	67 078 327 3
CHU STRASBOURG/HOP ROBERTSAU	67 078 005 5	67 078 313 3

Numéros FINESS des établissements PSPH

Hôpitaux	N° FINESS entité juridique	N° FINESS établissements
CTRE MEDICO-CHIRURG OBSTETRICAL	67 001 375 4	67 078 011 3
CLINIQUE BETHESDA	67 001 460 4	67 000 009 0

Numéros FINESS des établissements Privés

Hôpitaux	N° FINESS établissements
CLINIQUE DE L'ORANGERIE	67 078 017 0
CLINIQUE SAINTE-ODILE	67 078 038 6

2. Tables for black smoke findings

No results (BS are not measured in Strasbourg).

3. Tables for PM_{10} findings

3.1. Health effects of PM_{10} on 0-1 days

Tables 1, 2, 3 present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants. Table 4 presents the results for cardiac and respiratory hospital admissions.

Table 1. Deaths all causes (ICD9 < 800) (1999). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m³	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 µg/m³	196	11,23	7,48	15,00	2,49	1,66	3,32
50 µg/m³	8	0,79	0,52	1,05	0,17	0,12	0,23
By 5 µg/m³	NA*	9,74	6,49	12,97	2,16	1,44	2,88

**NA: not applicable*

Table 2. Cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m³	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 µg/m³	196	5,62	3,12	8,14	1,25	0,69	1,80
50 µg/m³	8	0,40	0,22	0,58	0,09	0,05	0,13
By 5 µg/m³	NA*	4,84	2,69	6,98	1,07	0,60	1,55

**NA: not applicable*

Table 3. Respiratory deaths (ICD9 460-519) (1999). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m³	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 µg/m³	196	2,71	1,04	4,40	0,60	0,23	0,98
50 µg/m³	8	0,19	0,07	0,32	0,04	0,02	0,07
By 5 µg/m³	NA*	2,31	0,89	3,73	0,51	0,20	0,83

**NA: not applicable*

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (2000). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year		
Scenarios	Number of days per year exceeding 20 and 50 µg/m^3	N° of deaths central	N° of deaths lower	N° of deaths upper
Hospital admissions for cardiac diseases (all ages)				
20 µg/m^3	196	11,23	5,61	16,88
50 µg/m^3	8	0,79	0,39	1,18
By 5 µg/m^3	NA*	9,74	4,87	14,59
Hospital admissions for respiratory diseases (all ages)				
20 µg/m^3	196	21,38	11,59	31,42
50 µg/m^3	8	1,52	0,83	2,24
By 5 µg/m^3	NA*	18,30	9,96	26,77

**NA: not applicable*

3.2. Cumulative health effects of PM_{10} up to 40 days

Tables 5, 6, 7 present the attributable number of all causes, cardiovascular and respiratory deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 5. Cumulative health effects of PM_{10} up to 40 days and all causes of deaths (ICD 9 < 800) (1999).Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	Number of days per year exceeding 20 and 50 µg/m^3	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 µg/m^3	196	23,02	15,16	30,85	5,10	3,36	6,84
50 µg/m^3	8	1,64	1,08	2,20	0,36	0,24	0,49
By 5 µg/m^3	NA*	19,66	12,99	26,25	4,36	2,88	5,82

**NA: not applicable*

Table 6. Cumulative health effects of PM_{10} up to 40 days and cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	**Number of days per year exceeding 20 and 50 µg/m^3**	**N° of deaths central**	**N° of deaths lower**	**N° of deaths upper**	**N° of deaths per 100 000 central**	**N° of deaths per 100 000 lower**	**N° of deaths per 100 000 upper**
20 µg/m^3	196	8,23	5,79	10,70	1,82	1,28	2,37
50 µg/m^3	8	0,60	0,42	0,78	0,13	0,09	0,17
By 5 µg/m^3	NA*	6,91	4,88	8,93	1,53	1,08	1,98

**NA: not applicable*

Table 7. Cumulative health effects of PM_{10} up to 40 days and respiratory deaths (ICD9 460-519) (1999). Potential benefits of reducing daily PM_{10} levels (2002) above 20 to 20 µg/m^3, above 50 to 50 µg/m^3 and all days by 5 µg/m^3. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of PM_{10}

		Attributable cases per year					
Scenarios	**Number of days per year exceeding 20 and 50 µg/m^3**	**N° of deaths central**	**N° of deaths lower**	**N° of deaths upper**	**N° of deaths per 100 000 central**	**N° of deaths per 100 000 lower**	**N° of deaths per 100 000 upper**
20 µg/m^3	196	8,86	2,25	15,94	1,96	0,50	3,53
50 µg/m^3	8	0,69	0,18	1,24	0,15	0,04	0,28
By 5 µg/m^3	NA*	7,06	1,84	12,36	1,56	0,41	2,74

**NA: not applicable*

3.3. Combined local and meta-analytic estimates for the health effects of PM_{10}

Not necessary (see above).

3.4. Long term HIA for PM_{10}

Table 9 presents the attributable number of all causes of deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 9. Deaths all causes (ICD9 < 800) (1999). Potential benefits of reducing annual mean values of PM_{10} (2002) to levels of 20 and 40 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 cases per year					
	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
20 μg/m^3	73,49	44,61	103,84	16,29	9,89	23,02
40 μg/m^3	0,00	0,00	0,00	0,00	0,00	0,00
By 5 μg/m^3	68,43	41,55	96,65	15,17	9,21	21,42

4. Tables for $PM_{2.5}$ findings

4.1. LT PM2.5: Attributable Cases

Tables 1, 2, 3 present the attributable number of all causes, cardiopulmonary and lung cancer deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. Deaths all causes (ICD9 0-999) (1999). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2002) to levels of 15 and 20 μg/m^3, and by 3,5 μg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Attributable cases per year					
	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
15 μg/m^3	54,13	14,11	94,73	12,00	3,13	21,00
20 μg/m^3	0,00	0,00	0,00	0,00	0,00	0,00
By 3,5 μg/m^3	68,44	17,81	119,98	15,17	3,95	26,59

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (1999). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2002) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Attributable cases per year					
	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
15 µg/m^3	26,67	9,59	44,07	5,91	2,13	9,77
20 µg/m^3	0,00	0,00	0,00	0,00	0,00	0,00
By 3,5 µg/m^3	33,69	12,09	55,78	7,47	2,68	12,36

Table 3. Lung cancer deaths (ICD9 162) (1999). Potential benefits of reducing annual mean values of $PM_{2,5}$ (2002) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Attributable cases per year					
	N° of deaths central	N° of deaths lower	N° of deaths upper	N° of deaths per 100 000 central	N° of deaths per 100 000 lower	N° of deaths per 100 000 upper
15 µg/m^3	12,55	4,24	21,07	2,78	0,94	4,67
20 µg/m^3	0,00	0,00	0,00	0,00	0,00	0,00
By 3,5 µg/m^3	15,83	5,33	26,66	3,51	1,18	5,91

4.2. LT PM2.5: Years of Life Lost

Tables 1, 2, 3 present the years of life lost of all causes, cardiopulmonary and lung cancer deaths expressed as absolute numbers and as rates per 100 000 inhabitants.

Table 1. Deaths all causes >30 years, male and female, for one year (ICD9 0-999) (2002). Potential benefits of reducing annual mean values of $PM_{2,5}$ (1999) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Years of life lost					
	YoLL central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m^3	25.89	6.83	44.72	5.70	1.51	9.85
20 µg/m^3						
By 3,5 µg/m3	32.29	8.54	55.71	7.12	1.88	12.27

Table 2. Cardiopulmonary deaths >30 years, male and female, for one year (ICD9 401-440 and 460-519) (2002). Potential benefits of reducing annual mean values of $PM_{2,5}$ (1999) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Years of life lost					
	YoLL central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m^3	14.64	5.34	23.79	3.22	1.18	5.24
20 µg/m^3						
By 3,5 µg/m^3	18.24	6.67	29.60	4.02	1.47	6.52

Table 3. Lung cancer deaths >30 years, male and female, for one year (ICD9 162) (2002). Potential benefits of reducing annual mean values of $PM_{2,5}$ (1999) to levels of 15 and 20 µg/m^3, and by 3,5 µg/m^3. Years of life lost (YoLL) and YoLL per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of $PM_{2,5}$

	Years of life lost					
	YoLL central	YoLL lower	YoLL upper	YoLL per 100 000 central	YoLL per 100 000 lower	YoLL per 100 000 upper
15 µg/m^3	3.41	1.18	5.58	0.75	0.26	1.23
20 µg/m^3						
By 3,5 µg/m^3	4.24	1.47	6.93	0.93	0.32	1.53