

LE HAVRE CITY REPORT

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France

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Table of contents

Summary of the main findings

Background

Sources

Exposure data

Health data

Health impact assessment

1. HIA scenarios

2. BS findings

3. PM10 findings

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

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

3. PM2.5 findings

3.1. Long-term attributable cases for PM2.5 measurements

3.2. Years of life lost for PM2.5 measurements

Interpretation of findings

General comments

Conclusions

Appendix

Le Havre CITY REPORT

Summary of the main findings

Air pollution levels and trends compared to EC limit values: daily and annual means of PM10 are under the EC limit values for 2005 ($50 \mu\text{g}/\text{m}^3$ not to be exceeded more than 35 times per calendar year for 24h-levels) in Le Havre. Therefore, the levels (daily and annual mean) remains a little bit above the limit values for 2010 ($50 \mu\text{g}/\text{m}^3$ not to be exceeded more than 7 times per calendar year for 24h-levels and $20 \mu\text{g}/\text{m}^3$ for annual mean).

The analysis estimated that reduction of the long-term PM pollution to the levels of PM2.5 of $15 \mu\text{g}/\text{m}^3$ would reduce mortality in Le Havre by 17 deaths in one year, which would save 6 years of expected life for starting year of simulation. If the daily means of PM10 would be kept under $20 \mu\text{g}/\text{m}^3$, 4 deaths and 16 respiratory and cardiac hospital admissions could have been avoided in the year 2000.

Main causes of air pollution in the city are industry and traffic, and planned actions to reduce it are reduction measures of industrial emissions.

Background

The metropolitan area of Le Havre is 199 km^2 size with a population of approximately 255 000 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.

In Le Havre, there are two political framework for public air quality management : the regional plan for air quality (PRQA) approved in December 2001 and the plan for air protection (PPA) which is in progress. PPA aims to take the necessary measures in order to follow the European policy on regulated pollutants such as SO_2 , NO_2 , PM10, O_3 .

Summary of local data and findings in Apehis second year (HIA)

For Apehis 2, only Black smoke (BS) were measured in 1998. The daily mean level (SD) of BS is $9.3 (9.2) \mu\text{g}/\text{m}^3$

Only the short-term Health Impact Assessment could be carried out on mortality and hospital admissions for respiratory diseases, over one year. No data were available for cardiac admissions.

Potential benefits of reducing daily BS	attributable case per year (SD)	rates per 100 000 inhabitants (SD)
death		
reduction of BS levels above 20 to $20 \mu\text{g}/\text{m}^3$	1.5 (0.8-2.1)	0.6 (0.3-0.8)
reduction by $5 \mu\text{g}/\text{m}^3$	5.9 (3.4-8.3)	2.3 (1.4-3.3)
hospital admissions for respiratory diseases		
reduction of BS levels above 20 to $20 \mu\text{g}/\text{m}^3$	0.0 (0.0-0.3)	

Objectives for Apheis 3 at the local level: HIA and minicase study.

The objectives for APHEIS 3 are to complete the PSAS-9 and APHEIS 2 results. It calculate absolute number of attributable deaths or hospital admissions to estimate again the short term impact of BS and estimate the health impact of short and long term exposure to air pollution from new indicators of particulate pollution (PM10, PM2.5 and BS). The health impacts of long term exposure to air pollution were estimated by calculate Years of life lost or reduction in life expectancy.

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:

Table 1. Main sources of air pollution

Source (year)	Road (%)	Heating (%)	Industry (%)	Other sources (specify)
SO ₂	0.7%	0.9%	97.4%	
NO _x	10.1%	2.2%	87.6%	
COVNM	14%	6.7%	79.2%	

38.4% of SO₂ 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

A permanent automated air pollution network (Air Normand) provided air pollution data. The agglomeration is covered by 13 fixed stations including 6 urban. The 2 measuring sites of PM2.5 were established during the year 2001 and PM10 are measured since 2000 by three urban stations. All measuring sites of BS have been changed since APHEIS II.

The exposure indicator was constructed by calculating the arithmetic mean of daily concentrations recorded by stations selected in the city area, which answer to the following criteria: the ambient urban stations had to be correlated (correlation ≥ 0.70) and to present close mean levels of pollution. For PM10, three urban stations were selected, for BS and PM2.5, two urban stations were selected.

Black smoke (BS) concentrations were measured by reflectometry.

PM10 and PM2.5 were measured by automatic analyser TEOM (Tapered Element Oscillating Microbalance).

After consultation of the reference laboratory in France for methods of measuring PM10, we used two correction factors for long term HIA calculations :

- in winter (increased levels of PM) : 1.25
- in summer (moderate levels of PM) : 1

These factors were based on comparative locally measurements between gravimetric and TEOM methods.

A conversion factor is used to converted PM2.5 from PM10 : 0.7

Exposure data for Apheis 3 :

- Year of air pollution data : 2000 for PM10 and BS; 2002 for PM2.5 measured
- Daily mean levels of PM10/BS/PM2.5 and SD:
 - Daily mean levels (SD) of PM10 were 21 $\mu\text{g}/\text{m}^3$ (8).
 - Daily mean levels (SD) of BS were 7 $\mu\text{g}/\text{m}^3$ (7).
 - Daily mean levels (SD) of PM2.5 were 13 $\mu\text{g}/\text{m}^3$ (8).
- P5 and P95:

The levels of PM10 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 11 $\mu\text{g}/\text{m}^3$ and 39 $\mu\text{g}/\text{m}^3$.

The levels of BS reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 2 $\mu\text{g}/\text{m}^3$ and 19 $\mu\text{g}/\text{m}^3$.

The levels of PM2.5 reached during the 18 days with the lowest (5th percentile) and the highest (95th percentile) levels were respectively 6 $\mu\text{g}/\text{m}^3$ and 29 $\mu\text{g}/\text{m}^3$.

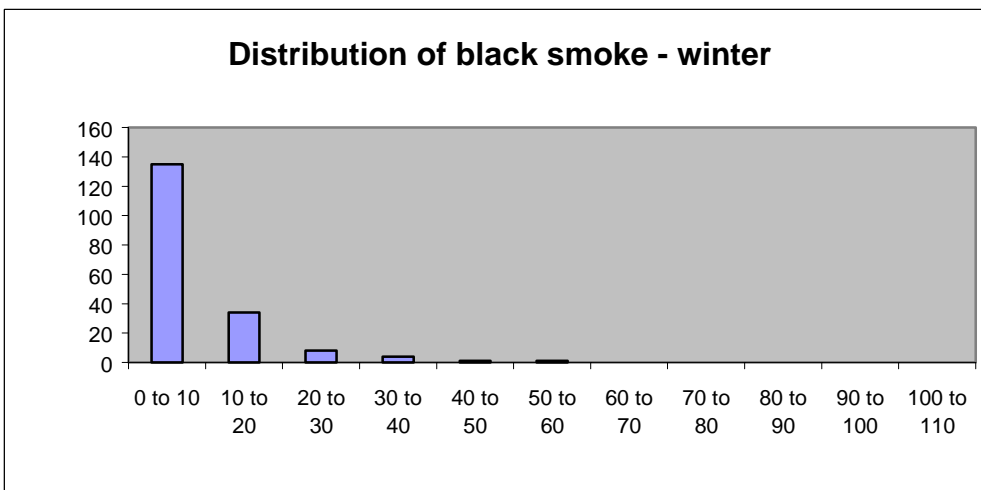
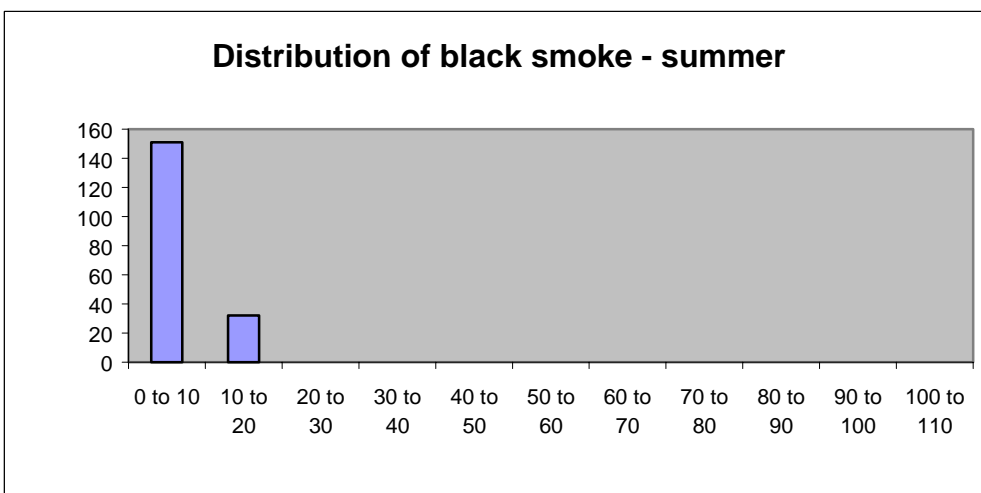
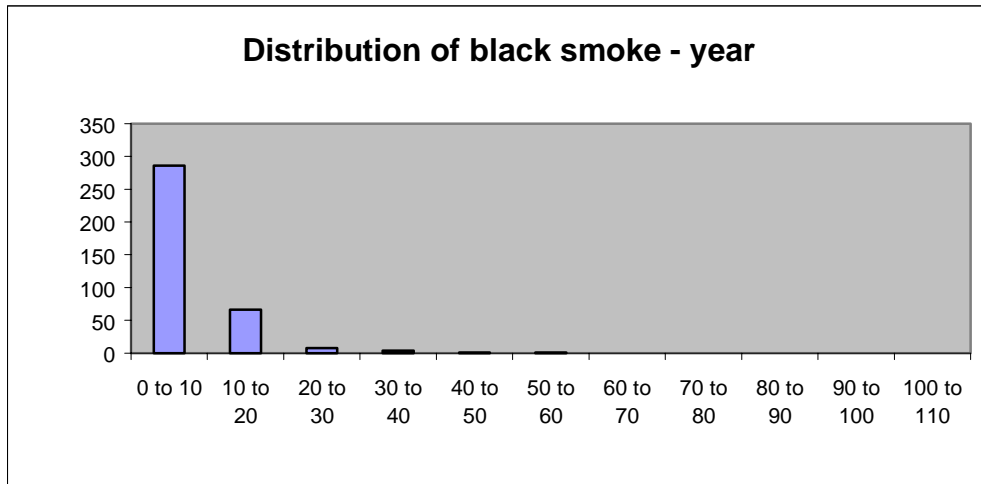
- Number of days when air pollutants exceeded limit levels:

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

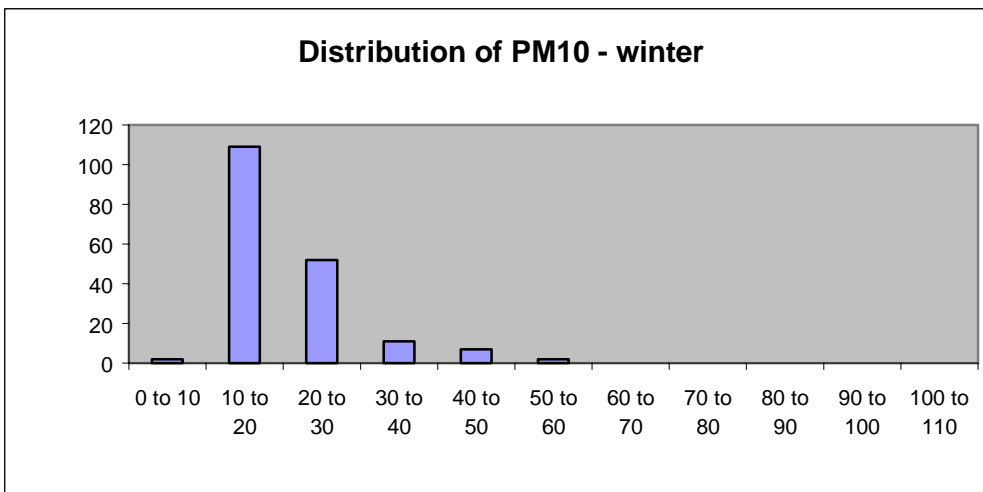
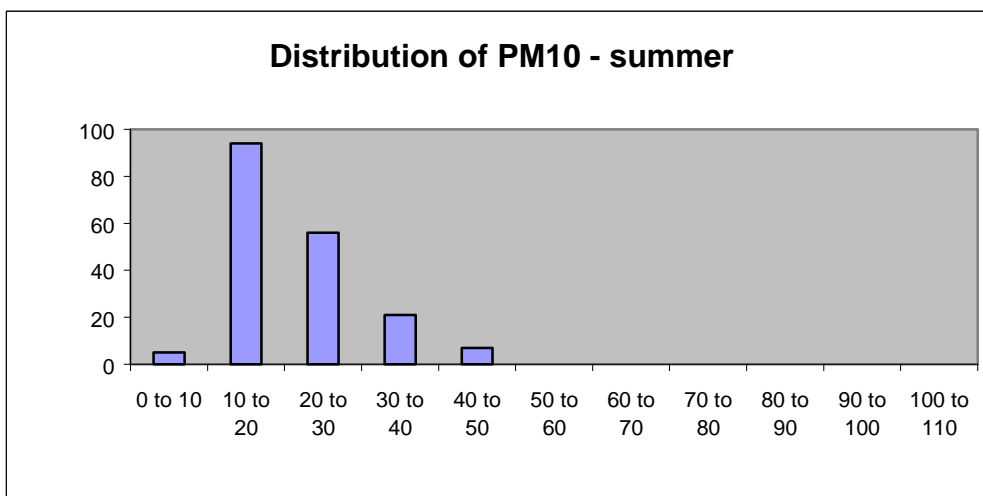
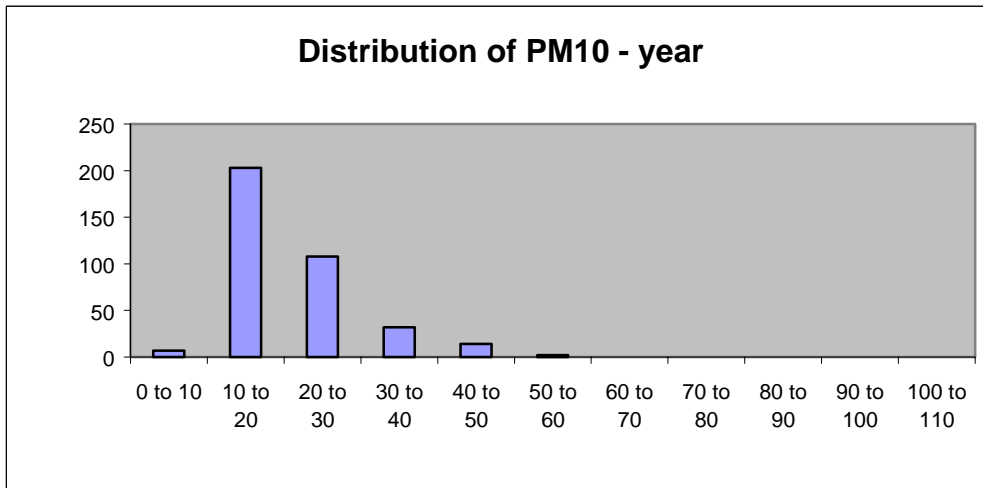
Air pollutant	Short term	
	PM10	BS
Number of days above 20 $\mu\text{g}/\text{m}^3$	20 $\mu\text{g}/\text{m}^3$	20 $\mu\text{g}/\text{m}^3$
	156	14
Number of days above 50 $\mu\text{g}/\text{m}^3$	50 $\mu\text{g}/\text{m}^3$	50 $\mu\text{g}/\text{m}^3$
	2	1

The 3 following figures show distributions of BS, PM10 and PM2.5 for year, summer and winter. The distributions patterns are not very different between winter and summer but the highest levels are measured in winter.

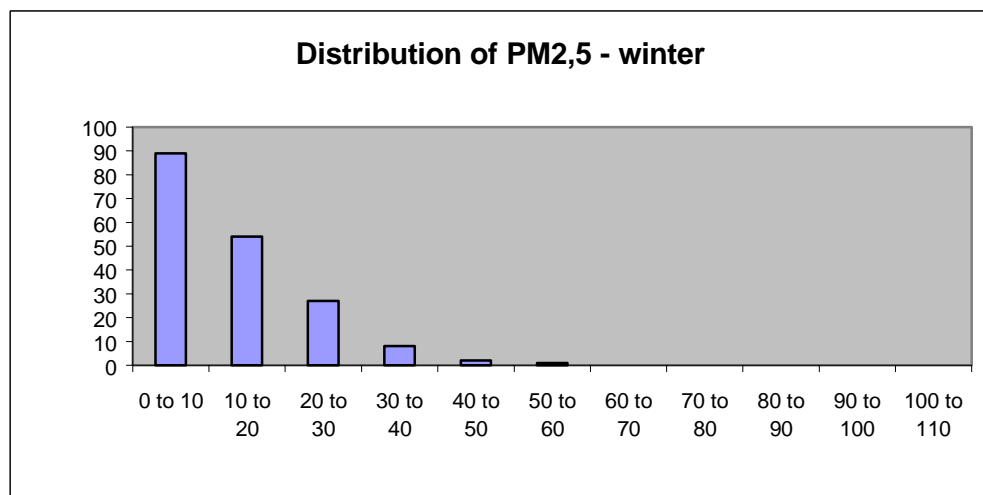
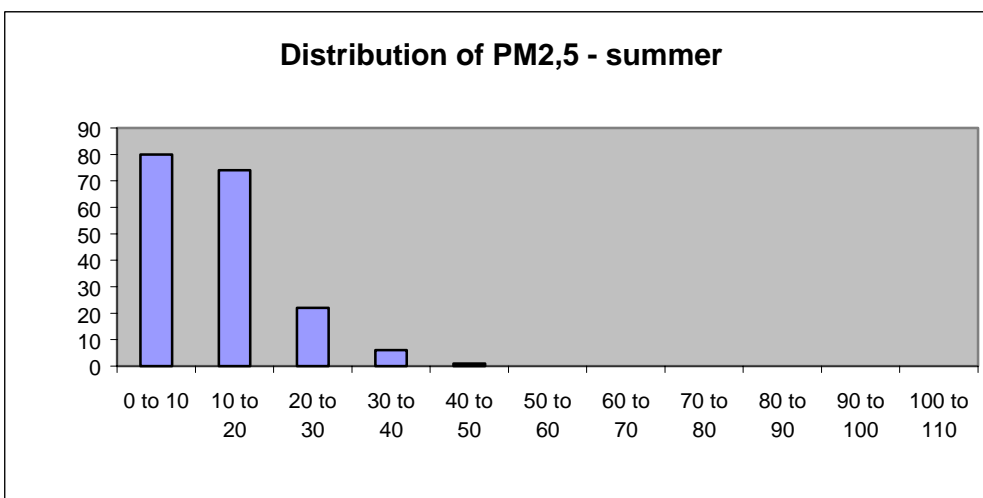
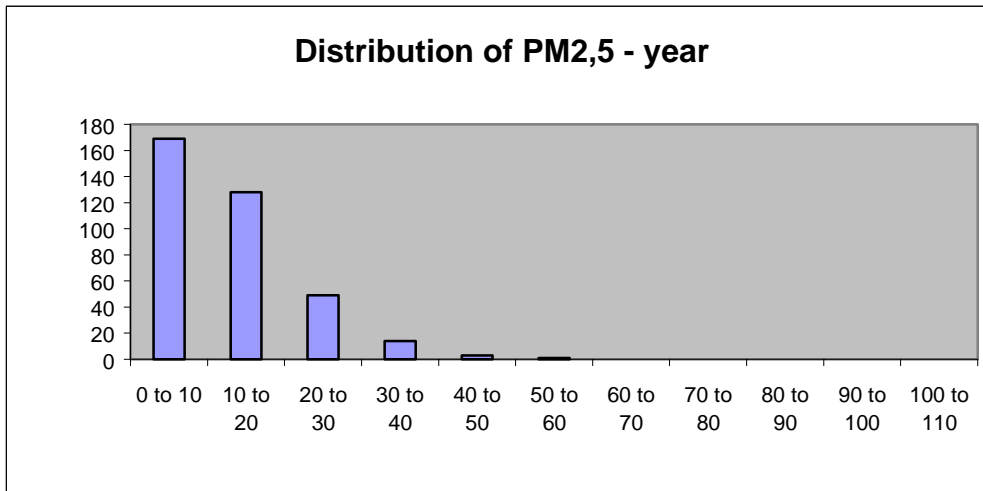
Figure 1,2,3. Distribution of Black smoke for 2000



Figures 4,5,6. Distribution of PM10 for 2000



Figures 4,5,6. Distribution of PM2.5 for 2002



Health data

Mortality data were provided by the Information Department specialised in mortality data (CepiDC) at the National Health and Medical Research Institute (INSERM). The more recent available data were for year 1999.

Data on hospitalisations for respiratory and cardiovascular diseases are provided by the Hospital Information Technical Agency (ATIH) from the hospital information system PMSI (Programme de médicalisation des systèmes d'information) for public and private hospitals in Le Havre. Respiratory and cardiovascular diseases are coded with ICD10. The data are available for year 2000 and results are presented in Table3.

Quality controls are carried out on hospital admissions and mortality data.

Age standardised mortality rate using European population was 870 per 100 000 inhabitants. Total European population (both sexes combined): 727 304 (in thousands) for year 2000 ¹.

Table 3 presents daily mean number and standard deviation, and daily or annual number of cases per 100 000.

Table 3. Daily mean number and annual rate per 100 000 of deaths (1999) and hospital admissions (2000)

Health outcome	ICD9	ICD10	Daily mean or annual count number (SD)	Number of cases per 100 000 (daily or annual rate)
Short term HIA				
All causes mortality (excluding external causes)*	< 800	A00-R99	5.72 (2.45)	2.2 (daily rate)
Cardiovascular mortality	390-459	I00-I99	1.74 (1.32)	0.70 (daily rate)
Respiratory mortality	460-519	J00-J99	0.52 (0.74)	0.20 (daily rate)
Cardiac hospital admissions	390-429	I00-I52	6.4	2.5 (daily rate)
Respiratory hospital admissions	460-519	J00-J99	7.9	3.1 (daily rate)
Long term HIA				
All causes mortality	0-999	A00-Y98	2258 (annual count)	889 (annual rate)
Cardiopulmonary mortality	401-440 460-519	I10-I70 J00-J99	762 (annual count)	300 (annual rate)
Lung cancer mortality	162	C33-C34	1124 (annual count)	44 (annual rate)

* 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 Le Havre these scenarios were built for three indicators of this particulate pollution: BS, PM10 and PM2.5. The estimated health impacts of these indicators

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

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).

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)	< 800	A00-R99	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) Aphis 3: 1.0114 (1.0062 - 1.0167)	
	All ages, cardiovascular mortality	390-459	I00-I99			
	All ages, respiratory mortality	460-519	J00-J99			
	All ages, cardiac hospital admissions	390-429	I00-I52			
	All ages, respiratory hospital admissions	460-519	J00-J99			
BS	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	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 et al. 2002: 1.011 (1.004 - 1.019) Aphis 3: 1.0030 (0.9985 - 1.0075)	
	All ages, cardiovascular mortality	390-459	I00-I99			
	All ages, respiratory mortality	460-519	J00-J99			
	All ages, cardiac hospital admissions	390-429	I00-I52			
	All ages, respiratory hospital admissions	460-519	J00-J99			
PM10 Distributed lag (40 days)	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	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)	
	All ages, cardiovascular mortality	390-459	I00-I99			
	All ages, respiratory mortality	460-519	J00-J99			
Complementary ST HIA for some cities reports						
PM10 with shrunken estimates	All ages, all causes mortality (excluding external causes)	< 800	A00-R99	French PSAS-9 Excel spreadsheet	Aphis 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 BS, short-term findings are expressed in terms of number of attributed deaths per year

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 the starting year of simulation.

Short-term scenarios

We used the following scenarios to estimate the acute effects of short-term exposure to BS/ PM10 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 $50 \mu\text{g}/\text{m}^3$ on all days exceeding this value
- reduction of BS levels to a 24-hour value of $20 \mu\text{g}/\text{m}^3$ on all days exceeding this value
- reduction by $5 \mu\text{g}/\text{m}^3$ of all the 24-hour values of BS.

Short term HIA scenarios for PM10 on 0-1 days and cumulative HIA of PM₁₀ up to 40 days

We used three scenarios to estimate the acute health effects of PM10 on 0-1 days and cumulative health effects of PM10 up to 40 days on all causes (excluding external causes), cardiovascular and respiratory mortality over one year:

- reduction of PM10 levels to a 24-hour value of $50 \mu\text{g}/\text{m}^3$ on all days exceeding this value (2005 and 2010 limit values for PM10)
- reduction of PM10 levels to a 24-hour value of $20 \mu\text{g}/\text{m}^3$ on all days exceeding this value (to allow for cities with low levels of PM10)
- reduction by $5 \mu\text{g}/\text{m}^3$ of all the 24-hour values (to allow for cities with low levels of PM10)

Long-term scenarios

Long-term HIA scenarios for PM10

We used three scenarios to estimate the chronic effects of long-term exposure to PM10 on all mortality causes (excluding external causes) over one year:

- reduction of the annual mean value of PM10 to a level of $40 \mu\text{g}/\text{m}^3$ (2005 limit values for PM10)
- reduction of the annual mean value of PM10 to a level of $20 \mu\text{g}/\text{m}^3$ (2010 limit values for PM10)x
- reduction by $5 \mu\text{g}/\text{m}^3$ in the annual mean value of PM10 (to allow for cities with low levels of PM10)

Long term HIA for PM2.5

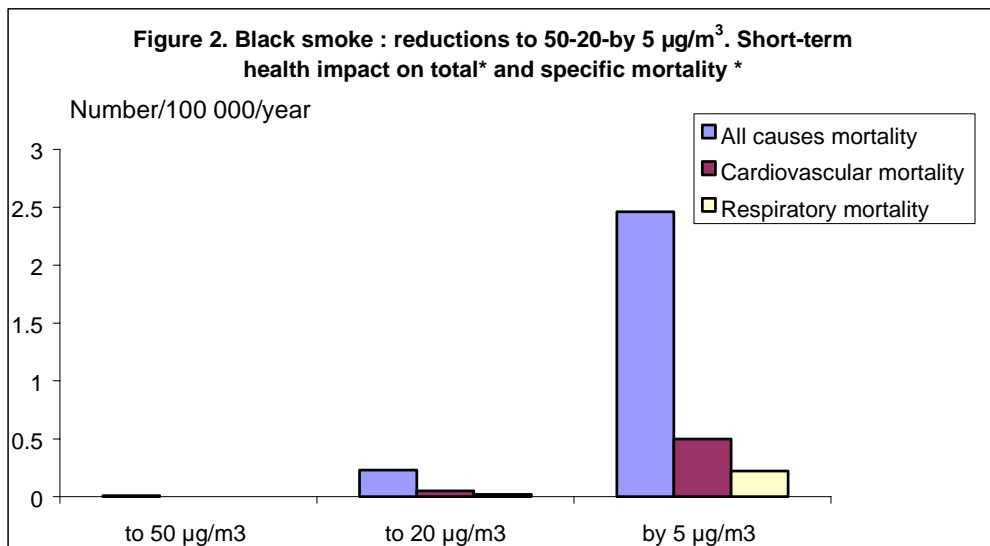
We estimated chronic effects of PM2.5 on the Le Havre population over 30 years old as impacts on mortality due to all causes, cardiopulmonary and lung cancer deaths.

The following three pollution scenarios were considered:

- reduction of the annual mean value of PM2.5 to a level of $20 \mu\text{g}/\text{m}^3$
- reduction of the annual mean value of PM2.5 to a level of $15 \mu\text{g}/\text{m}^3$
- reduction by $3.5 \mu\text{g}/\text{m}^3$ in the annual mean value of PM2.5 (to allow for cities with low levels of PM2.5)

BS findings

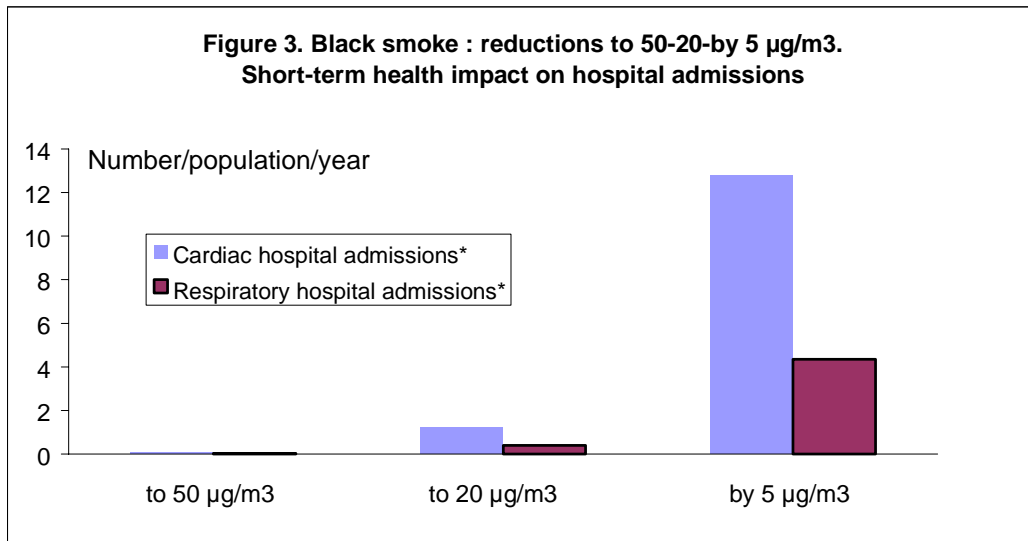
Figure 2 show the health impact of BS on all mortality causes (excluding external causes), cardiovascular mortality and respiratory mortality.



* All causes mortality excluding external causes (ICD9 < 800), cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519).

** Black smoke data for 2000, mortality data for 2000

Figure 3 show the health impact of BS on cardiac and respiratory hospital admissions.



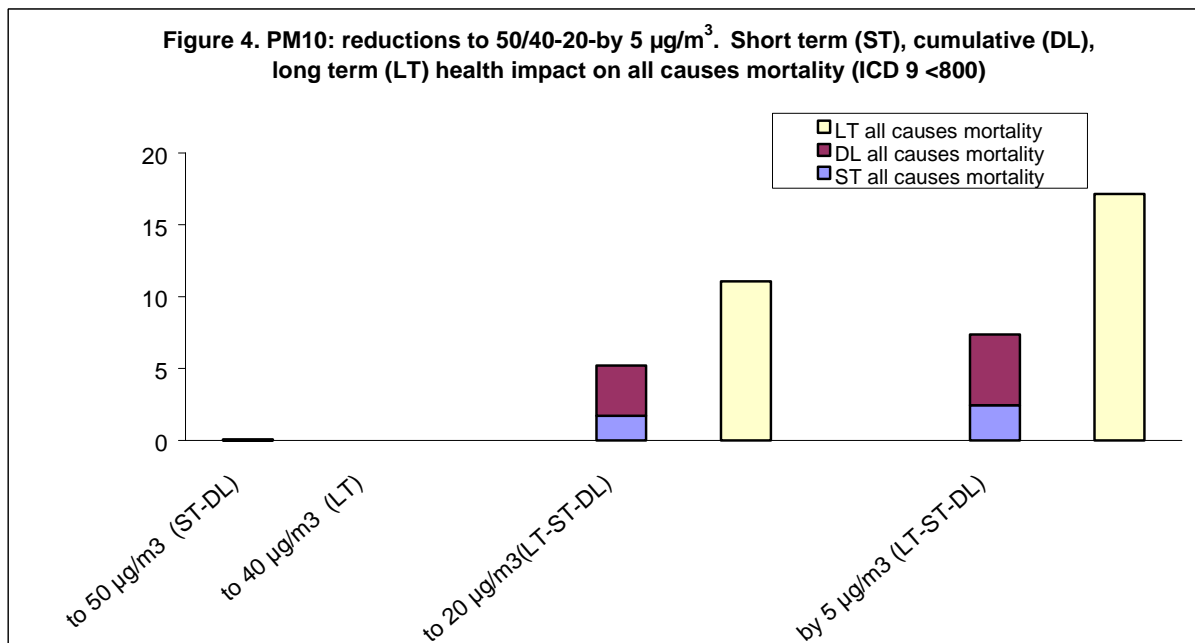
* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519)
 ** Black smoke data for 2000, mortality data for 2000

PM10 findings

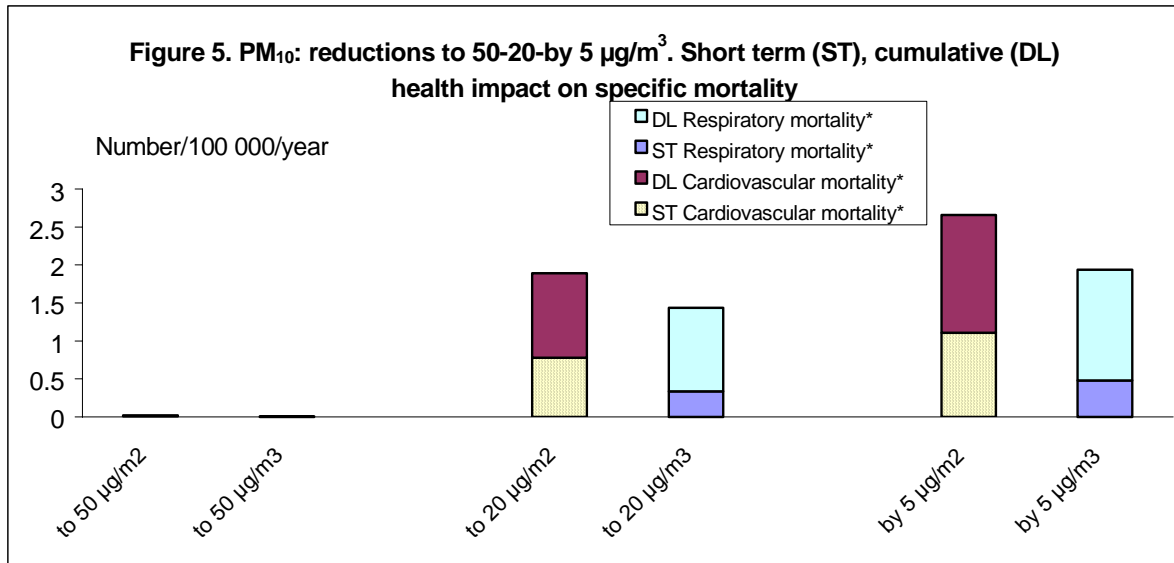
1. Short-term HIA of PM10 on 0-1 days and cumulative HIA of PM10 up to 40 days, and long term HIA of PM10

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).



* PM10 data for 2000, mortality data for 2000



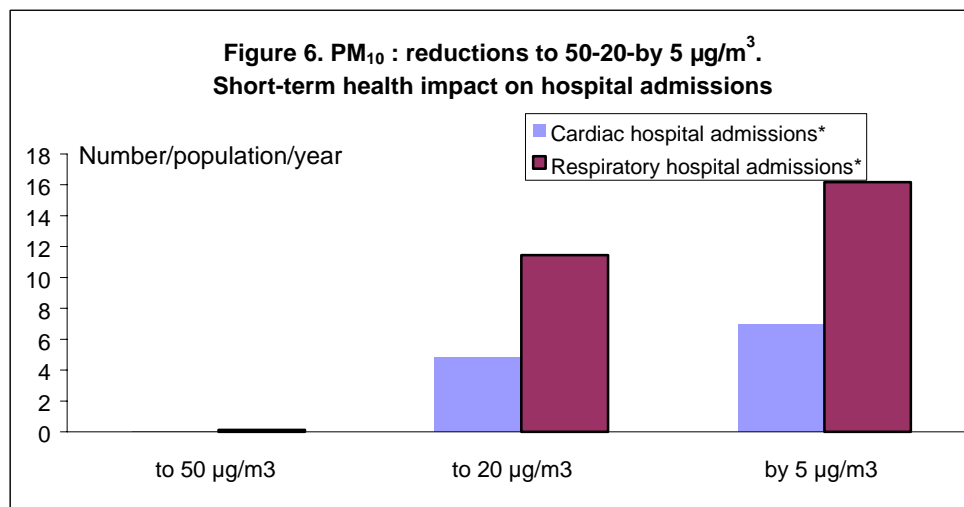
*Cardiovascular mortality (ICD9 390-459), respiratory mortality (ICD9 460-519).
 ** PM10 data for 2000, mortality data for 2000

The first scenario (to 50 µg/m³) health impact is null according to the moderate air pollution levels in Le Havre.

The results show the cumulative health effects is more than twice that the health effects of PM10 calculated on 0-1 days. Health impact is higher when the considered exposure duration is longer and effects are cumulative in the time. The long term impact on mortality is twice the DL impact.

1.2. Hospital admissions findings

We estimated the acute effects of short-term exposure to PM₁₀ on cardiac and respiratory hospital admissions over one year.



* Cardiac (ICD9 390-429) and respiratory hospital admissions (ICD9 460-519)
 ** PM10 data for 2000, mortality data for 2000

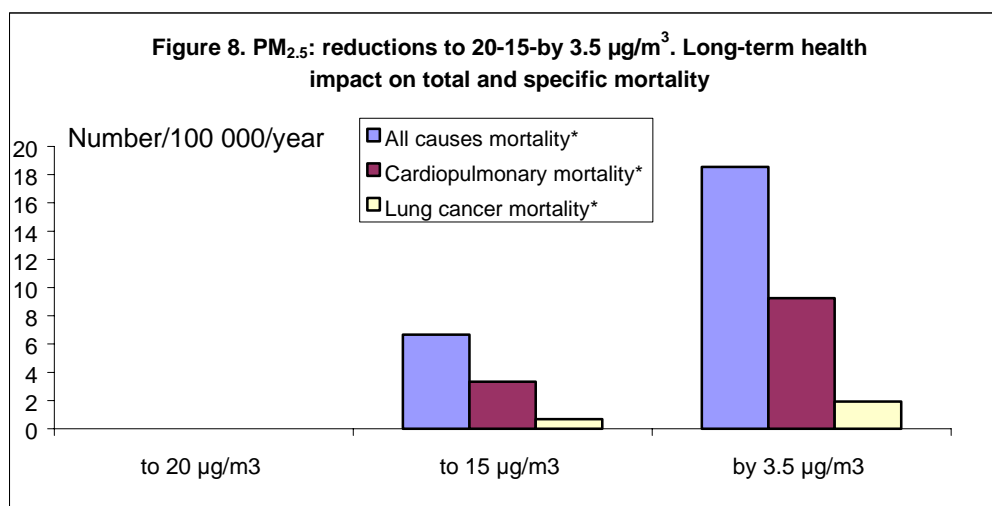
The health impact is more important for respiratory admissions because of a higher baseline frequency of them comparatively to the cardiac admissions. As in the precedent graphs, the first scenario health impact (to 50 $\mu\text{g}/\text{m}^3$) is negligible due to the moderate PM10 observed levels.

PM2.5 findings

1. Number of attributed cases

We also used three scenarios to estimate the chronic effects of long-term exposure to PM2.5 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.



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

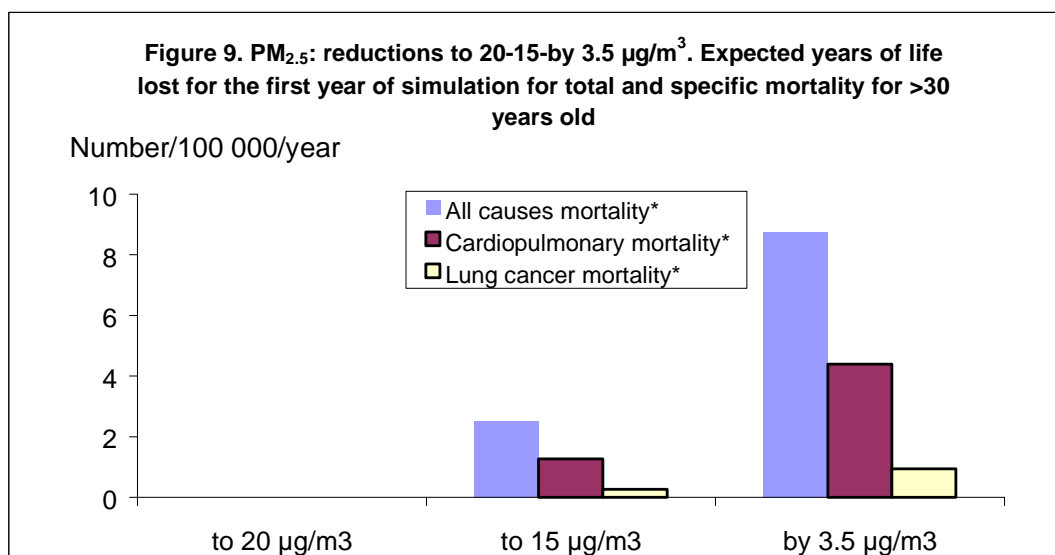
** PM2.5 data for 2000, mortality data for 2000

The health impact for the second scenario (to 15 $\mu\text{g}/\text{m}^3$) is lower than for the third scenario (by 3.5 $\mu\text{g}/\text{m}^3$) because the PM2.5 annual mean used for HIA (i.e. converted from corrected PM10 for TEOM measurements) is closed to 15 $\mu\text{g}/\text{m}^3$: 16 $\mu\text{g}/\text{m}^3$.

2. Years of life lost

We estimated the years of life lost attributable to the chronic effects of PM2.5 using the data for 2000. PM2.5 data were converted from corrected PM10 data.

Figure 9 presents the years of life lost for all causes, cardiopulmonary and lung cancer deaths for 30 years of age or older in Le Havre and its suburbs.



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

** PM_{2.5} data for 2000, mortality data for 2000

For all causes of deaths, all other things being equal, reduction of PM_{2.5} by 3.5 µg/m³ in 2000 would save around 22 years of expected life for starting year of simulation in people older than 30 years in the city of Le Havre and its suburbs (254 585 inhabitants). For cardiopulmonary mortality, this number would be more or less 11 and for lung cancer mortality, almost 2 years.

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

Table 5. Life expectancy and its possible increase by reduction of air pollution to 15 µg/m³ in Le Havre

Age	Life expectancy	Expected gain in life expectancy		
		Mean	Low estimate	High estimate
At birth	77.37	0.07	0.02	0.11
30	48.26	0.07	0.02	0.12
65	18.23	0.05	0.01	0.08

In terms of life expectancy, all other things being equal, if annual mean PM_{2.5} levels (16 µg/m³) would be reduced to 15 µg/m³, the 48.26 years of life expectancy in a person of 30 years old would increase by 0.07 year, due to reduced risk of death from all causes in Le Havre and its suburbs.

Interpretation of findings

Some comments can be made :

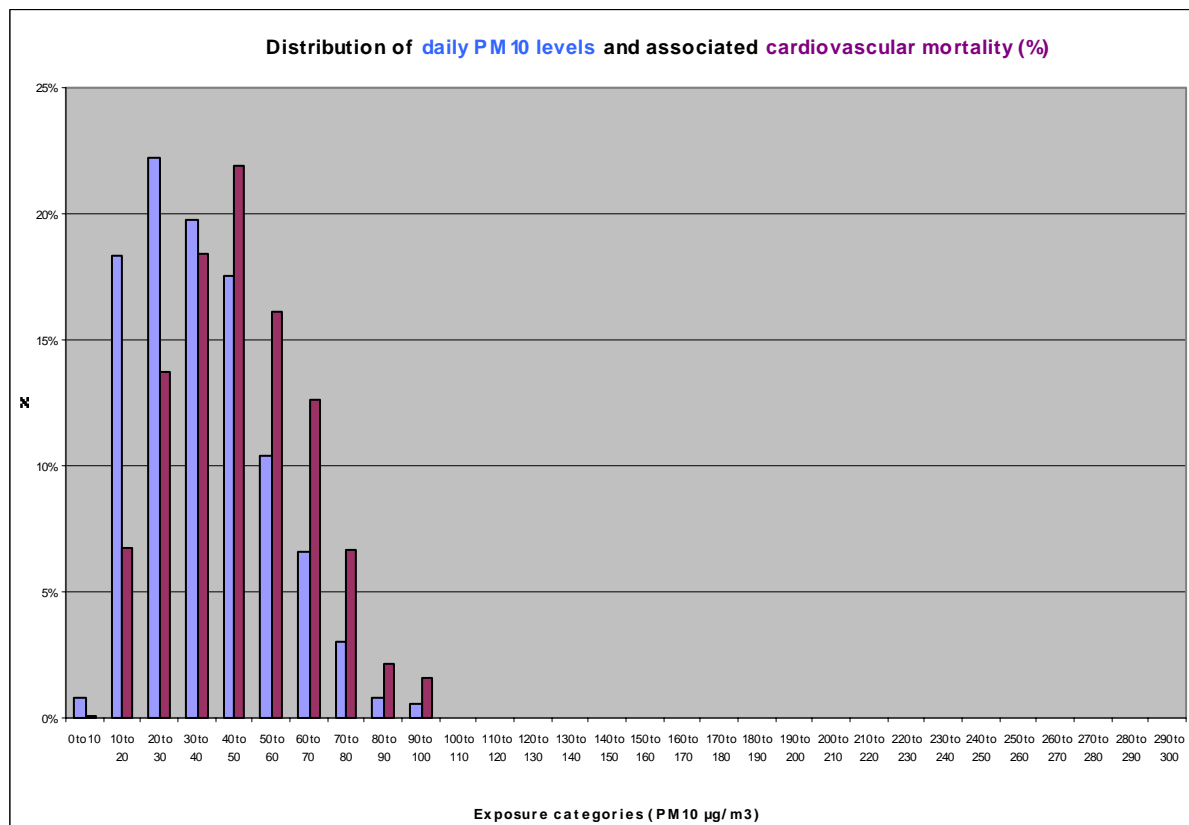
- Exposure assessment : In order to decrease potential exposure misclassification, the study area was defined using population exposure homogeneity criteria. First, this area does not present any discontinuance in urbanisation. Second, the work place of the majority of working inhabitants was located in the area. Third, air pollution data homogeneity (closed

means and high correlation coefficients) was checked on multi-sites measurements time series for PM and BS.

- Health outcomes : The health data principal lack stay in hospital admission data. Indeed these data correspond to total admissions and not only emergency admissions due to the registry organisation. This fact can overestimate the ST health impact assessment because included planned admissions cannot be related to ST exposure. Furthermore, admissions data for some private hospital are missed.
- findings : For Le Havre, daily concentrations were above the value of 20 et 50 for PM10 and BS and of 15 for PM2.5. Also, a reduction of levels during these days leads a small decrease in the number of attributable case.
For PM10 ,the results showed that health impact increases according to the exposure duration taken into account : LT impact is more important than DL impact which is more important than ST impact.
The results show that, in spite of moderate levels of air pollution, potential health benefits can be obtained by air quality improvement, seeing result for reducing annual mean values of PM2,5 by 3,5 $\mu\text{g}/\text{m}^3$. These findings are even more visible on the years of life lost results.
The air quality management consequence is that a long term air pollution decrease, even minimal, seems to be more effective than only air pollution peaks remove in term of health impact.

The next figure illustrates the relative impact importance of air pollution peaks during a few days compared to daily exposure to lower levels of air pollution over longer periods. In this example, only 4% of the associated health impact is attributable to levels of PM10 higher than 80 $\mu\text{g}/\text{m}^3$. Ninety six percent of the health impacts are observed for lower levels of PM10.

Short term distribution of PM10 levels and associated percentage of cases



General comments

These results complete those described in APHEIS2 report for Le Havre with health impact of PM10 and PM2.5. It confirms that potential health benefits can be obtained by air quality improvement even in cities with moderate levels of air pollution

Because the Atmospheric Protection Plan is in progress, it is still too early to truly assess the impact of results. A health working group is created to take into account public health aspects. The HIA results of PSAS-9 and APHEIS are mentioned in this document, but no management decisions have been taken up by now.

Conclusions

In conclusion, the HIA results and their interpretation will bring to the decision makers quantitative medical data elements and thus will clarify their choice of reduction and prevention policies of the risks having to be implemented.

For the PPA, the communication of air pollution's health impact to the general public will be developed and HIA results will be used.

Appendix

1. 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: | Le Havre |
| 2. | Total area of agglomeration (km ²): | 199 km ² |
| 3. | Area (km ²) covered by the air monitoring network in the city: | 199 km ² |
| 4. | Number of population in this (exposure relevant) area: | 254 585 |
| 5. | Total number of PM10 monitoring stations in this area: | 3 |
| 6. | Total number of BS monitoring stations in this area: | 6 |
| 7. | Total number of PM2.5 monitoring stations in this area: | 2 |
| 8. | Number of selected PM10 monitoring stations for HIA: | 3 |
| 9. | Number of selected BS monitoring stations for HIA: | 2 |
| 10. | Number of selected PM2.5 monitoring stations for HIA: | 2 |
| 11. | Measurement interval (please cross) | |
| | continuous (PM10/PM2.5) <input checked="" type="checkbox"/> hourly 24 hours (BS) <input checked="" type="checkbox"/> weekly | |
| | 2 weekly | |
| 12. | Quality assurance and control (please cross) | |
| | yes <input checked="" type="checkbox"/> no do not know | |
| 13. | Data quality (please cross) | |
| | validated data <input checked="" type="checkbox"/> invalidated data | |

2. Health data

2.1 Mortality data

Type of source	Year	Source	Quality control programme	% Missing data in basic cause death	Codification		
					ICD	Manual	Automatic
Register	1999	Institut National de la Santé et de la Recherche Médicale (CepiDC)	Yes	0%	ICD9	100%	

2.2 Hospital admissions data

Type of source	Year	Source	ICD	Quality control	Completeness (%)	% Missing data cause admission	Type of H. admissions	
							Total	Emergency
Register	2000	PMSI	10	Yes	100	0	X	

3. Tables for black smoke findings

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 BS levels (2000) 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 BS

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	N° of deaths			N° of deaths per 100 000		
		central	lower	upper	central	lower	upper
20 µg/m ³	14	0.58	0.39	0.87	0.23	0.15	0.34
50 µg/m ³	1	0.03	0.02	0.04	0.01	0.01	0.02
By 5 µg/m ³	NA*	6.26	4.17	9.38	2.46	1.64	3.69

*NA: not applicable

Table 2. Cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily BS levels (2000) above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effect of BS

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	14	0.12	0.06	0.21	0.05	0.02	0.08
50 $\mu\text{g}/\text{m}^3$	1	0.01	0.00	0.01	0.00	0.00	0.00
By 5 $\mu\text{g}/\text{m}^3$	NA*	1.27	0.64	2.23	0.50	0.25	0.88

*NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (1999). Potential benefits of reducing daily BS levels (2000) above 20 to 20 $\mu\text{g}/\text{m}^3$, above 50 to 50 $\mu\text{g}/\text{m}^3$ and all days by 5 $\mu\text{g}/\text{m}^3$. Absolute number and number per 100 000 inhabitants (95% confidence limits) attributable to the acute effects of BS

Attributable cases per year							
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 $\mu\text{g}/\text{m}^3$	14	0.05	-0.02	0.13	0.02	-0.01	0.05
50 $\mu\text{g}/\text{m}^3$	1	0.00	0.00	0.01	0.00	0.00	0.00
By 5 $\mu\text{g}/\text{m}^3$	NA*	0.57	-0.19	1.42	0.22	-0.07	0.56

*NA: not applicable

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

Attributable cases per year				
Scenarios	Number of days per year exceeding 20 and 50 $\mu\text{g}/\text{m}^3$	N° of admissions	N° of admissions	N° of admissions
		central	lower	upper
Hospital admissions for cardiac diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	14	1.20	0.44	2.09
50 $\mu\text{g}/\text{m}^3$	1	0.06	0.02	0.10
By 5 $\mu\text{g}/\text{m}^3$	NA*	12.79	4.66	22.06
Hospital admissions for respiratory diseases (all ages)				
20 $\mu\text{g}/\text{m}^3$	14	0.40	-0.20	1.00
50 $\mu\text{g}/\text{m}^3$	1	0.02	-0.01	0.05
By 5 $\mu\text{g}/\text{m}^3$	NA*	4.34	-2.17	10.83

*NA: not applicable

4. Tables for PM₁₀ findings

4.1. Health effects of PM₁₀ 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 PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths		N° of deaths per 100 000		N° of deaths per 100 000	
		central	lower	upper	central	lower	upper
20 µg/m ³	156	4.34	2.89	5.79	1.71	1.14	2.28
50 µg/m ³	2	0.05	0.03	0.06	0.02	0.01	0.02
By 5 µg/m ³	NA*	6.21	4.14	8.27	2.44	1.63	3.26

*NA: not applicable

Table 2. Cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths		N° of deaths per 100 000		N° of deaths per 100 000	
		central	lower	upper	central	lower	upper
20 µg/m ³	156	1.99	1.10	2.87	0.78	0.43	1.13
50 µg/m ³	2	0.02	0.01	0.03	0.01	0.00	0.01
By 5 µg/m ³	NA*	2.82	1.57	4.07	1.11	0.62	1.60

*NA: not applicable

Table 3. Respiratory deaths (ICD9 460-519) (1999). Potential benefits of reducing daily PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
		central	lower	upper	central	lower	upper
20 µg/m ³	156	0.86	0.33	1.39	0.34	0.13	0.55
50 µg/m ³	2	0.01	0.00	0.01	0.00	0.00	0.01
By 5 µg/m ³	NA*	1.21	0.47	1.95	0.48	0.18	0.77

*NA: not applicable

Table 4. Cardiac (ICD9 390-429) and respiratory (ICD9 460-519) hospital admissions (2000). Potential benefits of reducing daily PM₁₀ levels (2000) above 20 to 20 µg/m³, above 50 to 50 µg/m³ and all days by 5 µg/m³. Absolute number (95% confidence limits) attributable to the acute effects of PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year		
		N° of admissions	N° of admissions	N° of admissions
		central	lower	upper
Hospital admissions for cardiac diseases (all ages)				
20 µg/m ³	156	4.86	2.43	7.29
50 µg/m ³	2	0.05	0.03	0.08
By 5 µg/m ³	NA*	6.94	3.47	10.40
Hospital admissions for respiratory diseases (all ages)				
20 µg/m ³	156	11.44	6.21	16.78
50 µg/m ³	2	0.12	0.07	0.18
By 5 µg/m ³	NA*	16.17	8.81	23.66

*NA: not applicable

4.2. Cumulative health effects of PM₁₀ 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 PM₁₀ up to 40 days and all causes of deaths (ICD 9 < 800) (1999). Potential benefits of reducing daily PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths		N° of deaths per 100 000		N° of deaths per 100 000	
		central	lower	upper	central	lower	upper
20 µg/m ³	156	8.89	5.86	11.90	3.50	2.31	4.68
50 µg/m ³	2	0.09	0.06	0.13	0.04	0.02	0.05
By 5 µg/m ³	NA*	12.55	8.29	16.76	4.94	3.26	6.60

*NA: not applicable

Table 6. Cumulative health effects of PM₁₀ up to 40 days and cardiovascular deaths (ICD9 390-459) (1999). Potential benefits of reducing daily PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths		N° of deaths per 100 000		N° of deaths per 100 000	
		central	lower	upper	central	lower	upper
20 µg/m ³	156	2.83	1.99	3.67	1.11	0.78	1.44
50 µg/m ³	2	0.03	0.02	0.04	0.01	0.01	0.02
By 5 µg/m ³	NA*	3.94	2.78	5.09	1.55	1.09	2.00

*NA: not applicable

Table 7. Cumulative health effects of PM₁₀ up to 40 days and respiratory deaths (ICD9 460-519) (1999). Potential benefits of reducing daily PM₁₀ levels (2000) 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 PM₁₀

Scenarios	Number of days per year exceeding 20 and 50 µg/m ³	Attributable cases per year					
		N° of deaths		N° of deaths per 100 000		N° of deaths per 100 000	
		central	lower	upper	central	lower	upper
20 µg/m ³	156	2.79	0.72	4.97	1.10	0.28	1.96
50 µg/m ³	2	0.03	0.01	0.06	0.01	0.00	0.02
By 5 µg/m ³	NA*	3.72	0.97	6.51	1.46	0.38	2.56

*NA: not applicable

4.3. Long term HIA for PM₁₀

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 PM₁₀ (2000) to levels of 20 and 40 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 PM₁₀

	Attributable cases per year					
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
20 µg/m ³	28.11	17.10	39.65	11.06	6.73	15.60
40 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 5 µg/m ³	43.57	26.46	61.54	17.15	10.41	24.22

5. Tables for PM_{2.5} findings

5.1. LT PM_{2.5}: 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} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2.5}

	Attributable cases per year					
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	16.96	4.44	29.58	6.67	1.75	11.64
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	47.17	12.27	82.69	18.56	4.83	32.54

Table 2. Cardiopulmonary deaths (ICD9 401-440 and 460-519) (1999). Potential benefits of reducing annual mean values of PM_{2,5} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2,5}

Attributable cases per year						
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	8.48	3.06	13.95	3.34	1.21	5.49
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	23.51	8.44	38.92	9.25	3.32	15.32

Table 3. Lung cancer deaths (ICD9 162) (1999). Potential benefits of reducing annual mean values of PM_{2,5} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. Absolute number of deaths and number of deaths per 100 000 inhabitants (95% confidence limits) attributable to the chronic effects of PM_{2,5}

Attributable cases per year						
	N° of deaths	N° of deaths	N° of deaths	N° of deaths per 100 000	N° of deaths per 100 000	N° of deaths per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	1.76	0.60	2.94	0.69	0.24	1.16
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	4.87	1.64	8.20	1.92	0.64	3.23

5.2. 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) (1999). Potential benefits of reducing annual mean values of PM_{2,5} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. 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	YoLL	YoLL	YoLL per 100 000	YoLL per 100 000	YoLL per 100 000
	central	lower	upper	central	lower	upper
15 µg/m ³	6.42	1.69	11.13	2.51	0.66	4.36
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	22.31	5.9	38.48	8.74	2.31	15.08

Table 2. Cardiopulmonary deaths >30 years, male and female, for one year (ICD9 401-440 and 460-519) (1999). Potential benefits of reducing annual mean values of PM_{2,5} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. 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	YoLL	YoLL	YoLL	YoLL	YoLL
	central	lower	upper	per 100 000	per 100 000	per 100 000
15 µg/m ³	3.23	1.17	5.28	1.27	0.46	2.07
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	11.19	4.09	18.16	4.39	1.6	7.11

Table 3. Lung cancer deaths >30 years, male and female, for one year (ICD9 162) (1999). Potential benefits of reducing annual mean values of PM_{2,5} (2000) to levels of 15 and 20 µg/m³, and by 3,5 µg/m³. 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	YoLL	YoLL	YoLL	YoLL	YoLL
	central	lower	upper	per 100 000	per 100 000	per 100 000
15 µg/m ³	0.7	0.24	1.15	0.27	0.09	0.45
20 µg/m ³	0.00	0.00	0.00	0.00	0.00	0.00
By 3,5 µg/m ³	2.4	0.83	3.93	0.94	0.33	1.54