Interreg Illa-project **EXPER/PF**Frans-Vlaams Deelprogramma nr. 2.1.1. 2002-2004

EXposition des **P**opulations vivant au coeur de l'Euro-**R**égion aux polluants atmosphériques: le cas des **P**oussières **F**ines

Blootstelling van de bevolkingsgroepen wonend in het hart van de Euregio aan polluerende atmosferische deeltjes: het geval van de fijne stofdeeltjes

FINAL REPORT

Richard Santer (ULCO-Adrinord)
Corinne Schadkowski (APPA)
Aymeric Blanchet (APPA)
Jean-Yves Saison (AREMA)
Charles Poinsot (OPAL'AIR)
Didier Ramon (HYGEOS)
Edward Roekens (VMM)
Leen Verlinden (VMM)
René Van Grieken (UA)
Marianne Stranger (UA)
Jan Mees (VLIZ)

VLIZ Special Publication 22 2005

Met de steun van







Deze publicatie dient als volgt geciteerd te worden:

Santer R.; Schadkowski C.; Blanchet A.; Saison J.-Y.; Poinsot C.; Ramon D.; Roekens E.; Verlinden L.; Van Grieken R.; Stranger M.; Mees J. (2005). EXPER/PF – Exposition des populations vivant au coeur de l'Euro-Région aux polluants atmosphériques: le cas des poussières fines - Blootstelling van de bevolkingsgroepen wonend in het hart van de Euregio aan polluerende atmosferische deeltjes: het geval van de fijne stofdeeltjes - Final Report. VLIZ Special Publication, 22. Vlaams Instituut voor de Zee (VLIZ): Oostende, Belgium. 92 pp.

Vlaams Instituut voor de Zee (VLIZ) Flanders Marine Institute Wandelaarkaai 7 B-8400 Oostende, Belgium Tel. +32-(0)59-34 21 30 Fax +32-(0)59-34 21 31

E-mail: info@vliz.be http://www.vliz.be

Niets uit deze uitgave mag worden verveelvoudigd en/of openbaar gemaakt worden door middel van druk, fotokopie, microfilm of op welke andere wijze ook zonder voorafgaandelijke schriftelijke toestemming van de uitgever.

ISSN 1377-0950



EXPER/PF

Exposition des Populations vivant au cœur de l'Euro-Région aux polluants atmosphériques : le cas des Poussières Fines

Blootstelling van bevolkingsgroepen wonend in het hart van de Euregio aan atmosferische deeltjes: het geval van de fijne stofdeeltjes

Final report

Report Version: 1

Report Preparation Date: 5 January 2005 Report Delivery Date: 1 February 2005

Classification: Public

Contract Start Date: 01 January 2003

Duration: 36 months

Project Co-ordinator: ADRINORD

ADRINORD	ADRINORD : Association pour le Développement de la Recherche et de l'Innovation dans le Nord Pas de Calais
Association pour la Prévention de la Politición Atmosphérique	APPA: Association pour la Prévention de la Pollution Atmosphérique
A.R.E.M.A	AREMA Lille Métropole sur l'arrondissement de Lille
HYGEOS	HYGEOS HYdrogéologie, Observation Spatiale, Environnement
OPALAIR Hander - Cole of Opale	OPAL'AIR pour les arrondissements de Boulogne, Calais, Dunkerque et Saint-Omer.
	VLIZ : Vlaams Instituut voor de Zee vzw (coordination et information de la recherche maritime en Flandre).
V M M V V V V V V V V V V V V V V V V V	V.M.M. Vlaamse Milieumaatschappij (Société Flamande pour l'Environnement).
	Partenaire Associé/Onderaannemer : Université d'Anvers (UA)



Project funded by the European Community under the INTERREG III-a Programme



LIST OF ACRONYMS

ARVI: Atmospheric Resistant Index **AOT:** Aerosol Optical Thickness

EO: Earth Observation

ESA: European Space Agency

MERIS: MEdium Resolution Imaging Spectrometer

NRT: Near Real Time
PM: Particle Matter

SeaWiFS: Sea Wide Field Sensor

TOA: Top Of Atmosphere

WHO: World Heath Organisation

TABLE OF CONTENTS

1- Introduction	3
2- The data base	5
2.1 Air quality network	5
2-2. Aerosol remote sensing	20
2-3. The data base	36
3 – The pilot study	57
3.1 Campaigns with mobile laboratories	58
3.2. Measurements at Menen and Kortrijk	69
3.3 Dioxins and PCB126 7370	72
4 – Communication	75
4-1. Scientific development monitoring and transfer of knowledge	75
4-2. Project Promotion	75
Appendix	84
5 – Outlook	89
6- Conclusion	92

1. INTRODUCTION

1.1 General context

Air quality is of major concern and the relevant legislation is changing rapidly. The fine particle abundance is one of the indicator for air quality and therefore subject to an official norm: PM_{10} and $PM_{2.5}$ are the mass per unit volume corresponding to Particle Matter of diameter respectively less than 10 μ m and 2.5 μ m. These particles are the most likely to penetrate in the respiratory system.

European directives indicate for air quality the objectives to be reached at short and medium terms. For example, the 22/02/1999 EC directive imposes an upper limit of $50 \mu g/m^3$, which can not be over passed more than 35 days a year, and that before 01/01/2005. The norm will become even stricter in 2010 with a maximum of seven days.

Nevertheless, last decade scientific studies demonstrated that the impacts on human health do not only result of dust episode occurrence but that the permanent exposition to dust is relevant as well. More over, the chemical composition of the aerosols is assumed to be a key parameter.

1.2 The Euro regional context at the beginning of the project

Air quality networks exist both in France and in Belgium. Ground based stations are well equipped for gaseous pollutant monitoring. PM measurements were implemented progressively in order to apply the new EC directive.

Catalogues of emission exist but they mainly concern major production units. Therefore, they are poor indicators of the domestic and traffic productions.

INTERREG -2, between Flanders and France, offered with the AEROSOL project a first opportunity to set a trans border cooperation on air quality with:

- (i) a demonstration of the potentiality for Earth Observation to monitor from space the aerosols.
- (ii) A pilot study to evaluate the transborder transportations of air pollutants along the common coast of the North Sea.

1.3 EXPER/PF objectives.

Three major objectives were proposed:

- (i) A transfrontier data base for PM, see section 2.
- (ii) A pilot study around Lille, see section 3;
- (iii) An education of different publics through communication activities, see section 4.

2. Action 1: The PM data base

2.1 Air quality network

2.1.1 The pollutants

Sulphur dioxide (SO₂)

SO₂ is a gaseous pollutant, which is encountered around industrial areas. It originates from the combustion of fossil combustible (fuel, charcoal) by industry and domestic heating. It is responsible for respiratory damages in case of high concentrations. The ambient concentrations are decreasing for several years at the same time of improvement of industrial processes.

Particulate matter (PM)

The term PM is equivalent to the term atmospheric aerosol and defines a suspension of air-borne solid particles and/or droplets of various sizes. A single particle usually contains a mixture of chemical and physical (solid, liquid) constituents.

The PM10 concentration is the mass per volume unit (µg/m3) of particles with an aerodynamic diameter smaller than 10 micrometer (µm). When inhaled, the larger particles contained in the PM10 size fraction reach the upper part of the lung. The smaller particles of this size fraction (in particular PM2,5 and PM1,0) penetrate more deeply into the lung and reach the alveolar region.

Size and composition of ambient PM not only depend on the emission process, but also, particularly for the finer fractions, on the atmospheric processes that the particles go through after emission. The particle mass is usually found in two size-related modes. The finer mode, up to around 1 µm, generally originates from high temperature processes and/or gas-to-particle formation processes in the atmosphere; these particles carry inorganic compounds (such as sulphates, nitrates and elemental carbon) and organic compounds, including semi-volatile components. Mechanical processes such as erosion, corrosion and material abrasion give rise to coarser particles, usually larger than 1 µm. These particles carry e.g. soil components and sea spray. Another fraction, the ultrafine particles (UFP), in size below 0.1 µm, is better characterised by the number concentration (number of particles per cm³), because despite their large number they contribute only little to the particulate mass. Large and very small particles have a limited atmospheric residence time due to deposition or coagulation. Particles in the size range between approximately 0,1 and a few µm remain much longer in the atmosphere (typically several days to a week) and can consequently be transported over long distances (1000 or more kilometres).

PM is emitted directly from 'primary' sources (primary PM) and is also formed in the atmosphere by reaction of precursor gases (secondary PM). The main precursor gases are SO₂, NO_x, VOC and NH₃. Other common distinctions are natural/anthropogenic sources and combustion/non-combustion sources.

A large body of scientific evidence has emerged that has strengthened the link between ambient PM exposure and health effects. New analyses have shown death being advanced by at least a few

months on population average, at current PM concentrations in Europe, for causes such as cardiovascular and lung disease. Furthermore, there are robust associations between ambient PM and increases in lower respiratory symptoms and reduced lung function in children, and chronic obstructive pulmonary disease and reduced lung function in adults. There is no evidence for a threshold below which ambient PM has no effect on health. In its recent review, WHO has concluded that there is a causal relationship between PM exposure and health effects. It has not however been possible to establish a causal relationship between PM-related health effects and one single PM component. This is in spite of intensive research roughly over the last decade. Nevertheless there is strong evidence to conclude that fine particles - usually measured as PM2,5 in health effects studies - are more hazardous than larger ones. This does not imply that the coarse fraction of PM10 is innocuous. PM characteristics found to contribute to toxicity include: metal content, presence of polycyclic aromatic hydrocarbons and other organic components, endotoxin content and small (less than 2,5 µm) and extremely small (less than 0,1 µm) size. Epidemiological studies suggest that a number of emissions sources are associated with health effects, especially motor vehicles and also coal combustion. Toxicological studies show that particles originating from internal combustion engines, coal burning, residual oil combustion and wood burning have strong inflammatory potential.

Nitrogen monoxide (NO) and nitrogen dioxide (NO₂)

The nitrogen oxides are generated by all combustion sources (domestic heating, automobile traffic) because of the reaction between nitrogen and oxygen at high temperature and by industrial processes (chemical industry). So they have two different origins and they are encountered in all types of environment. The emitted nitrogen monoxide reacts quickly with air to transform itself in nitrogen dioxide. At high concentrations nitrogen dioxide can provoke respiratory damages.

Ozone (O₃)

We call ozone a secondary pollutant because it does not come directly from human activity but results from a photochemical reaction between nitrogen oxides and volatile organic compounds (VOC) under the influence of sunlight. The reaction is more efficient when the temperature is high. Ozone results from the dissociation of NO_2 under the influence of sunlight. It reacts with NO emitted by human activities to build an equilibrium. It is the reason why the rural concentrations of ozone are a little bit higher than urban concentrations. This equilibrium is broken in the presence of VOC, which also reacts with NO. At this moment, O_3 isn't destroyed anymore and increases.

Ozone provokes respiratory damages and ocular problems. At high concentrations, it can provoke an asthmatic crisis by sensible persons.

Ammonia (NH₃)

Ammonia mainly originates from agricultural activities. Cattle farming, depot and distribution of animal fertiliser, are the most important sources of ammonia in the atmosphere. Next to cattle farming, traffic is a growing source of ammonia emission, due to the increasing use of catalysators.

Carbon monoxide (CO)

Carbon monoxide comes from incomplete combustion. Its principal source is the explosion engine of vehicles. It is a pollutant found in high concentrations near the important traffic roads or in places with bad dispersion (canyon streets or indoor). Carbon monoxide can lead to death if high doses are inspired.

Heavy metals

Most of the heavy metals have a toxic or carcinogenic character. They are adsorbed on suspended particles, which is the principal way of entering the body. The industry and traffic mainly emit them.

Volatile organic compounds (VOC)

The gaseous combinations of carbon and hydrogen occurring in nature and polluted air encompass a large spectrum of the organic chemistry. Carbon can form combinations with hydrogen, oxygen, sulphur, chlorine, fluorine and with carbon itself to form straight chains, branched chains, cyclic compounds and cyclic compounds with branching. So the number of organic compounds is practically unlimited.

The most important sources of volatile organic compounds are industrial processes and traffic.

Poly-aromatic hydrocarbons (PAH)

The poly-aromatic hydrocarbons are composed of more than one aromatic ring. They occur in a large measure in complex mixtures as soot, oil products, smoke of cigarettes, the exhaust of cars and residues of the production of gas from coal. Exposure to each of these complex mixtures is associated to an elevated mortality by cancer. PAH are harmful because of their known carcinogenic and mutagenic properties.

PAH are products of incomplete combustion and pyrolysis of fossil fuels and other organic materials from natural and anthropogenic sources. The higher the temperature of formation of a PAH compound, the higher its risk to human health. In urban and industrial atmospheres, PAH are almost entirely from anthropogenic origin. PAH are present in the atmosphere both in the vapour and the condensed phase. The most hazardous representatives of these ubiquitous compounds have been found to be associated with suspended particulate matter.

The most important emissions are realised by domestic heating, traffic and industry, especially the wood and furniture industry.

Dioxins and PCBs

The term "dioxins" covers a group of 75 polychlorinated dibenzo-p-dioxin (PCDDs) and 135 polychlorinated dibenzofurans (PCDFs). They became publicly known due to the Seveso accident. Dioxins have a flat molecular structure composed of two benzene rings linked by two oxygen atoms. Four chloride atoms are implanted on the benzene rings.

Figure: Structure of dioxins

Dioxins are formed essentially as **unintentional by-products** in a number of chemical processes as well as during any incomplete combustion process. They are extremely resistant to chemical and biological degradation and therefore persist in the environment. They have been shown to exert a number of toxic responses, including dermal toxicity, immunotoxicity, endocrine disruption and carcinogenicity. The most important route for human exposure to PCDDs and PCDFs is consumption of products of animal origin and fish. Contamination of food is primarily caused by deposition of emissions of various sources (e.g. waste incineration, production of chemicals, metal industry) on farmland and a subsequent accumulation in the food chain in which they are particularly associated with fat. Therefore investigations of deposition samples are able to indicate the pollution of the environment with PCDDs and PCDFs.

Among the family of dioxins only the 2,3,7,8- substituted congeners are toxicologically important. Hence, the analysis of deposition is focused on these 17 congeners.

The toxicity of dioxins is evaluated by use of toxic equivalency factors "TEF". The TEFs relate the toxicity of a given 2,3,7,8- substituted dioxin to that of 2,3,7,8-TCDD, the most toxic congener (TEF=1). TEF values in combination with chemical residue data can be used to calculate toxic equivalent TEQ concentrations. Several TEF schemes have been developed. In the past, the International TEFs (I-TEFs) have been used; nowadays the TEFs calculated by the World Health Organisation (WHO) are internationally considered as the standard values.

Table: WHO-TEF of PCDDs and PCDFs

Component	WHO -TEF	Component	WHO-TEF
Dibenzodioxins		Dibenzofurans	
2,3,7,8-TCDD	1	2,3,7,8-TCDF	0,1
1,2,3,7,8-PeCDD	1	1,2,3,7,8-PeCDF	0,05
1,2,3,4,7,8-HxCDD	0,1	2,3,4,7,8-PeCDF	0,5
1,2,3,6,7,8-HxCDD	0,1	1,2,3,4,7,8-HxCDF	0,1
1,2,3,7,8,9-HxCDD	0,1	1,2,3,6,7,8-HxCDF	0,1
1,2,3,4,6,7,8-HpCDD	0,01	1,2,3,7,8,9-HxCDF	0,1
OCDD	0,0001	2,3,4,6,7,8-HxCDF	0,1
		1,2,3,4,6,7,8-HpCDF	0,01
		1,2,3,4,7,8,9-HpCDF	0,01
		OCDF	0,0001

PCBs

Polychlorinated biphenyl's "PCBs" are a group of 209 different congeners. The structural difference with dioxins is that PCBs have no oxygen atoms between their benzene rings.

Figure: Structure of PCBs

PCBs are **intentionally produced** chemicals manufactured in the past for a variety of industrial uses, notably as electrical insulators or dielectric fluids and specialised hydraulic fluids. Most countries banned the manufacture and use of PCBs in the 1970s. However, past improper handling of PCBs constitutes a continuing source of PCBs in the environment, and disposal of equipment now in use poses some risk of further contamination. The source of PCBs pollution depends on the type of uses. There are two types of uses of PCBs:

<u>Closed uses</u>: dielectric fluids in electrical equipment. From these uses, the main sources of releases are: leakage, fires, accidents, illegal dumping and inadequate disposal.

<u>Open uses</u>: as pesticide extenders, flame retardants, sealants, paints...From these uses the main sources of releases are: landfilling, migration, air emission from evaporation.

Other less significant sources are waste incineration, sewage sludge application to land, combustion of waste oils, as well as the evaporation from PCB reservoirs, such as marine and river sediments and harbour slugs.

PCBs can be divided into groups according to their toxicological properties: 12 congeners exhibit toxicological properties similar to dioxins and are therefore often termed "dioxin-like PCBs". Those 12 congeners have a flat molecular structure and are called "coplanar PCBs". The other PCBs do not exhibit dioxin-like toxicity and have a different toxicological profile. According to dioxins, the coplanar PCBs are extremely resistant to chemical and biological degradation and therefore persist in the environment and accumulate in the feed and food chain. The toxicity of coplanar PCBs is evaluated in the same way as dioxins, which means with TEF related to 2,3,7,8, -TCDD. Table 1.2. demonstrates that, among the coplanar PCBs, PCB126 is the most toxic congener. Although dioxins are far more toxic than PCBs, it has to be taken in account that the quantities of PCBs released to the environment are several times higher. Due to budgetary considerations, only the deposition of the most toxic PCB congener (PCB126) was measured.

Table: WHO-TEFs of PCB

Non-ortho Coplanar PCB's	WHO-TEF	Mono-ortho Coplanar PCB's	WHO-TEF
3,3',4,4'-TetraCB (77)	0.0001	2,3,3',4,4'-PentaCB (105)	0.0001
3,4,4',5-TetraCB (81)	0.0001	2,3,4,4',5-PentaCB (114)	0.0005
3,3',4',4',5-PentaCB (126)	0.1	2,3',4,4',5-PentaCB (118)	0.0001
3,3',4,4',5,5'-HexaCB (169)	0.01	2',3,4,4',5-PentaCB (123)	0.0001
		2,3,3',4,4',5-HexaCB (156)	0.0005
		2,3,3',4,4',5'-HexaCB (157)	0.0005
		2,3',4,4',5,5'-HexaCB (167)	0.00001
		2,3,3',4,4',5,5'-HptaCB (189)	0.0001

Physical parameters

Next to the chemicals pollutants, several physical parameters relative to the atmosphere were recorded: pressure, temperature, relative humidity, wind speed and wind direction and rainfall. These parameters are very useful to know where the pollution comes from and where it goes to. It permits to explain the presence of ozone, the dispersion of the pollutants or the increase of particulate matter coming directly from the ground under the effect of the wind. The wind parameters are used to build a pollution rose. This analysis tool is obtained by classifying the concentration of a pollutant for each wind direction.

The wind direction is expressed in degrees referred to the north. The north direction is expressed by the 0 value. The value 90 means that the wind comes from the east, the value 180 means that the wind is coming from the south and a value 270 indicates that wind coming from the west is blowing.

2.1.2 Sampling, analysis method and data treatment of the compounds

Automatic monitors

Sampling and measurement method

The mobile stations and fixed stations are equipped with an inoxydable sampling head situated on the roof. The manifold is constituted of a teflon or glass cylinder protected from the rain by a metallic cover. Several short lines are connected on the manifold until each monitor. The air is aspired in the principal line by a high volume pump. The analysed air is this situated around the station. The pumping of air is a continuous process. Each monitor has its own pump and samples the necessary volume of air from the manifold.

The particles are pumped through a special head, which selects those, whose diameter is less than 10 μ m. The larger particles impact on the impaction plate and stop. The smaller ones are carried by the flow in the monitor. To determine particles of less than 2,5 μ m a sharp cut cyclone is added to modify the flow pattern of the particles according to their size.

The pollutants measured with the automatic monitors in the mobile laboratories and the fixed stations are analysed with the method mentioned in the European legislation. They are indicated in table 1.3.

Table: Table of measurement methods of the automatic monitors

Pollutant	Method	Directive reference
Sulphur dioxide	Ultra-violet fluorescence	1999/30/CE
Nitrogen oxides	Chemiluminescence	1999/30/CE
Particulate matter	Tapered Element Oscillating Microbalance (*) β-absorption (*)	1999/30/CE
Ozone	Ultra-violet Absorption	2002/3/CE
Carbon monoxide	Non-dispersive infra-red spectrometry	2000/69/CE

^(*) TEOM or β-absorption is not the normative method but member's states can use other methods if they show its equivalence to the normative method.

Calibration of monitors

At the beginning and at the end of each campaign, the monitors measuring gaseous pollutants were calibrated using standardised operating procedures. Gas bottles filled with one pollutant at a well-known concentration are presented to the monitors. The concentration of the gas bottles is compared to the standards of the country. In France, they belong to Laboratoire National d'Essais. In Flanders the standards are ministered by the Interregional Cell for the Environment (IRCEL). The PM monitors are calibrated using filters with a well-known mass. The flow is regularly checked.

Data validation

At AREMA LM the data are validated using a method from 'Agence de l'Environnement et de la Maitrise de l'Energie' (Règles et recommandations en matière de validation des données, critères d'agrégation, et paramètres statistiques, mars 2002). These rules define the different steps of the validation with the necessary analysis tools and the required knowledge of the person who treats the data.

First, a value is calculated by the data logger system. If the monitor functions correctly for at least 12 minutes out of 15 minutes, the data logger uses all the elemental responses obtained (about one every ten seconds) to calculate a mean value. If the monitor has a problem (heating, problem of an element,...), it sends a fault code and the mean value is coded with this fault. If the monitor fails, there is no data. These 15 minutes values are the basic values.

Secondly, a person has to control the values. He considers technical points like regular autocontrols of the monitor, response of the monitor to a known sample of gas (the zero and span check), importance of the defaults, environmental points like the comparison with other monitors, the effect of meteorology and the chemical reaction between pollutants to validate or invalidate the values. When these basic values are validated, it is possible to calculate hourly values, daily values and so on. To obtain an hourly value, it is necessary to have 3 quarter values out of 4 (75%). To obtain a daily value, 75% of hourly values on the period are needed, what corresponds to 18 hourly values per day.

The validation procedure at VMM is not imposed by external rules, but the followed procedure is very similar. The basis values are half hourly values. To obtain an hourly value, it is necessary to have the two half-hourly values. To obtain a daily value, 50% of the half-hourly values on the period are needed, what corresponds to 24 half-hourly values per day.

The temporal reference of a data is the moment of the end of the measurement. So the value indicated at 9:00 corresponds to the sampling between 8:00 and 9:00.

The time used is universal time (UT). We have to add one hour in winter (between end of October and end of March) and two hours in summer to obtain the local time.

Calculation of hourly and daily values

The rules of data treatment are universal. The arithmetic means are calculated with the formula:

$$Average = \frac{\sum_{i}^{N} C_{i}}{N}$$

where Ci is the ambient concentration at i (quarter, half hour, hour)

N is the number of correct data in the hour or in the day.

Concentration units

The gas analysers measure a number of molecules of a specified gas in a volume of air. So, we obtain concentration in micromole/mole (ppm) or nanomole/mole (ppb). To have a correspondence with the European Directives, it is necessary to express the results in mass by volume unit. To do this, we consider that air is a perfect gas in normal conditions of temperature (20°C) and pressure (101325 Pa). The concentrations are expressed in µg/m³ or mg/m³.

Uncertainty

The uncertainty on the value given by the monitor depends on a lot of parameters, which influence the measurements. They are:

- -the environment such as the ambient temperature, the pressure, the humidity
- -the sampling: length and cleanness of the line
- -the monitor: its metrological properties (drift, linearity, repeatability...)
- -the calibration.

This uncertainty is difficult to evaluate. The regular cleaning operations and the calibrations permit to have uncertainty as lower as possible. The European Directive asks for an uncertainty of no more than 15% for SO₂, NO₂, NO₃, NO₃ and CO and of no more than 25 % for PM and benzene.

Heavy metals

For the metals AREMA LM used Partisol-Plus2025 Samplers equipped with a PM10 head. The flow is 1 m³/h. Quartz filters (Whattman) were used. The filters were changed automatically every week.

Sampling at the VMM sites was carried out using Leckel (Leckel SEQ 47/50) PM10 and PM2,5 samplers. The flow is 2,3 m³/h. Cellulose nitrate filters (Sartorius) were used. The filters were changed automatically every day.

AREMA LM works with the Institut Pasteur de Lille who obtained an accreditation for the analyses of heavy metals. The filters are mineralised with 5 ml of nitric acid in PTFE bomb under microwaves. The solutions are completed with 50 ml H₂O and are used for the analysis of metals. Depending on the sensitivity of the metal, the analyses are effected using Ion Coupled Plasma with Argon Emission Spectrometry or Ion Coupled Plasma with Mass Spectrometry.

For the determination of the heavy metal content in particulate matter in the VMM laboratory wavelength dispersive X-ray fluorescence technique (WD-XRF) is used. Standard filters for the XRF equipment are prepared by aerosol generation. For the calibration of the XRF methods VMM is using flame and graphite furnace atomic absorption spectrometry to determine the heavy metal content in the standard filters.

UA used a Tracor Spectrace 5000 EDXRF instrument for the determination of heavy metals in particulate matter. The equipment uses a low power Rh-anode X-ray tube (17.5 Watts). The characteristic X-ray radiation was detected by a Si(Li) detector. For determining high-Z (starting from K) elements, an accelerating voltage of 35 kV and a current of 0.35 mA were used. The acquisition time was set at 10000 seconds. The measured intensities were converted into elemental concentration by application of the AXIL program (B. Vekemans et al., 1994).

The gravimetric determination of PM10 and PM2,5 mass collected on the filter is performed by the determination of the weight of blank and sampled filters with a microbalance.

Volatile organic compounds (VOC)

VOC were measured with an automatic BTEX monitor. The monitor gives each half-hour the concentration of benzene, toluene, ethylbenzene, xylene isomers, C3-alkylbenzene isomers, C4-alkylbenzene isomers and naftalene.

The ambient air is sampled automatically over an adsorption tube that adsorbs the pollutants. By thermal desorption the substants are eluted and then transported on an analytical capillaire column. This column separates the components and after the separation the detection is done with a photo ionisation detector (PID). The detection limit for all the compounds is $0,1 \,\mu g/m^3$.

Sampling of gaseous compounds by means of diffusion tubes (NO2, SO2, BTEX and NH3)

Radiello diffusion tubes were used by VMM and UA to sample various gaseous compounds. Depending on the compound to be detected, different types of tubes were used. The diffusion tubes of each type were exposed during 14 days subsequently, spread over one year. According to the manual provided by the manufacturer, the diffusion tubes were analysed by UA with appropriate analytical techniques. NO₂ and SO₂ were detected as nitrite, sulphite and sulphate by ionchromatography. NH₃ was measured as the blue coloured indophenol by means of visible spectrophotometry. Benzene, toluene, ethylbenzene, ortho-xylene and the sum of meta- and para- xylene were detected by means of coupled gaschromatography – mass spectrometry.

Poly-aromatic hydrocarbons (PAH)

VMM collects the polycyclic aromatic hydrocarbons over a glass fibre filter. The flow is 54 m³/h. After extraction with dichloromethane they are analysed with high performance liquid chromatography with fluorescense detection.

AREMA LM collects the PAH on quartz filters with a diameter of 150 mm using a high volume sampler of 30 m³/h. The rythm of collect is 1 day out of 6. The analysis protocol is identical.

For PAH determination at UA filter samples were extracted using pressurised liquid extraction. The extracts were concentrated in a Turbo Vap 500 concentrator and the solvent was exchanged into 1 ml acetonitrile prior to their analysis for the presence of 10 PAH using HPLC in combination with programmed fluorescence detection. The HPLC system consisted of a liquid chromatography system and a fluorescence detector. Separation of the PAH was accomplished using a Vydac 201TP column (250 mm x 4.6 mm), with a gradient elution ranging from a 50/50 acetonitrile-water mixture to 100% acetonitrile in 20 min. The fluorescence of PAH was monitored with automatic adjustment of the wavelength for each compound according to the retention time. The excitation wavelengths ranged between 260 and 300 nm, the emission wavelengths between 380 and 465 nm.

Dioxins and PCBs

The atmospheric emissions of dioxins are the main input into the environment and, as such, the key factor to human uptake via the food chain. The monitoring of the dioxin and "dioxin-like PCBs" deposition gives, besides the emission measurements, and control, an independent complementary assessment. Moreover, it allows the detection of important sources of dioxin and dioxin-like PCBs.

The samples are collected in Bergerhoff deposition gauges, as described in the German VDI 2090/1 Entwurf-standard of December 1999. A set of 3 glass jars with 9,5 cm inner diameter, 20 cm high is placed on a 1,5 m high pole for a period of 30 ± 3 days. The Bergerhoff gauge was chosen because it is made of glass and can be heated to 450° C, in order to obtain low blank values. In order to obtain an uniform collection efficiency during the whole sampling period 1 cm of water was added at the start.

The content of the 3 gauges is put together and analysed as one sample. The dioxins (17 congeners) are analysed by gas - chromatography linked with high-resolution mass-spectrometry (GC - HRMS). The detection limits of the congeners are below 1 pg.m⁻².d⁻¹ fulfilling the VDI 2090 standard. If a

congener has a level below the detection limit, the half of the detection limit is taken for further calculation.

Measuring the dioxin pollution by deposition measurement has several advantages. The price of the collectors (Bergerhoff gauges) is rather low. Therefore, large-scale campaigns with low cost equipment may be performed. As the collectors are small and no electricity is needed, gauges can be placed on private ground. The duration of sampling time is rather long (1 month) implicating that performing a few analyses can cover a large period. The long sampling duration does enhance the risk of losing compounds due to degradation resulting in an underestimation of the dioxin deposition. Additionally, the vapour phase cannot be measured.

2.1.3 Description of stations

see paragraph 3.1.1

2.1.4 Legislation concerning atmospheric pollution

The EU-Framework Directive about Air Quality appeared on 27th September 1996. This Framework Directive established a list of 13 pollutants for which requirements should be described in subsequent Daughter Directives. The first Daughter Directive (1999/30/EC) gave air quality norms (limit values and alarm thresholds) for SO₂, NO_x, PM10 and lead. Margins of tolerance were in most of the cases associated with the limit values. The second Daughter Directive (2000/69/EC) gave limit values for carbon monoxide and benzene. The third Daughter Directive (2002/03/EC) proposed target values and thresholds for ozone. Since ozone does travel over borders and since it is a secondary pollutant whose production is highly influenced by meteorological parameters, no legal limit values were proposed by the EU-Commission. A proposal for the fourth Daughter Directive is being discussed on the moment. Non-mandatory target values are proposed for arsenic, cadmium, nickel and benzo(a)pyrene.

Sulphur dioxide (SO₂)

The table below gives an overview of the future limit values and the alert threshold for SO_2 (1999/30/EC). The limit values (hourly and daily) for the protection of human health must be reached by 1st January 2005. The compliance date to the limit value for the protection of ecosystems (vegetation) was 19th July 19 2001. The margin of tolerance for SO_2 (hourly limit value for the protection of human health) was set at 43 % at the entry into force of that Directive (19th July 1999). The margin of tolerance decreases linearly from 1/1/2001 to 0% at the date where the limit value must be reached (1/1/2005). As far as the daily limit value for the protection of human health is concerned, no margin of tolerance was given.

Table: Future limit values for the protection of health for SO_2 coming into force on 1/1/2005 and alert threshold for SO_2 in 2001 (1999/30/EC)

HOURLY LIMIT VALUE for the	350 μg/m³ not to be exceeded more than 24 times a calendar
PROTECTION of HUMAN HEALTH	year
DAILY LIMIT VALUE for the	125 μg/m³ not to be exceeded more than 24 times a calendar
PROTECTION of HUMAN HEALTH	year
ALERT THRESHOLD	500 μg/m³ over 3 consecutive hours

PM10 and PM2,5

There were no EU-norms for PM10 until 1999. The Directive 1999/30/EC proposes 2 phases. The limit values in phase 1 must be reached by 1st January 2005 whereas those in phase 2 must be reached by 1st January 2010. The limit values of phase 2 are only indicative and have to be revised when more information is obtained about the effects on health and the environment, about technical feasibility and from the results of phase 1.

The limit values (daily and yearly) for the protection of human health from phase 1 must be reached by 1st January 2005. Margins of tolerance (MOT) were proposed together with the limit values. The margin of tolerance for PM10 in phase 1 at the entry into force of that Directive (19th July 1999) was set at 50% for the daily limit value and 20% for the yearly limit value. These margins of tolerance decrease linearly from 1/1/2001 to 0% at the date where the limit values must be reached (1/1/2005).

The table below gives an overview of the future limit values (phase 1) for PM10 (1999/30/EC).

Table: Future limit values for PM10 (phase 1) coming into force on 1/1/2005

DAILY LIMIT VALUE for the	50 μg/m³ PM10 not to be exceeded more than 35 times a
PROTECTION of HUMAN HEALTH	calendar year
ANNUAL LIMIT VALUE for the	
PROTECTION of HUMAN HEALTH	40 μg/m³ PM10

So far there are no limit values for PM2,5 inside the European Union. The EU only requires member states to do measurements. The 2003/37/EC Decision gives a reference method for the sampling and analysis of PM2,5. The sole limit value that can be found at the present time is that of the American Environmental Protection Agency (EPA). The EU Working Group proposes 20 µg/m³ as the future yearly limit value. Following table gives an overview of the EPA limit values for PM2,5.

Table: EPA limit values for PM2,5

DAILY LIMIT VALUE	65 μg/m³
ANNUAL LIMIT VALUE	15 μg/m³

The reference method for the measurement of PM10 is described in the European Standard EN12341. The reference measuring method consists of a PM10 sampling inlet, directly coupled with a filter substrate and a regulated flow device, followed by gravimetric determination of the PM10 mass collected on the filter. Other methods, e.g. attenuation of β -radiation or the oscillating mass balance method, can be used if their equivalence to the reference method can be demonstrated or if there is a consistent relationship with the reference method (European Directive 1990/30/EG). Automatic monitors for the measurement of PM10 usually give lower results due to the volatization of volatile materials, like

volatile organic materials and components with ammonia. A reference method for PM2,5 is not yet determined.

In Flanders comparative measurements were executed in 2001 and 2002. A correction factor of 1,37 is used for the β -absorption monitors and a correction factor of 1,47 is used for the TEOM monitors. Corrected PM10-values in Flanders are named PM_{ref}-10 in this report. In France, a campaign took place in the summer 2001 and the winter 2001-2002 for 2 months in several towns (Marseille, Lille, Strasbourg, Rouen, Lyon, Toulouse, Grenoble) to compare TEOM and Partisol on daily sampling. The ratios obtained are about 1,1 in summer and 1,3 in winter with values reaching 1,8 in case of high concentration of PM. So, it was decided in France to avoid the use of a correction factor, also not to use the European suggested factor of 1,3.

Nitrogen dioxide (NO₂)

This table shows the future limit values for NO_2 and NO_x and the alarm threshold for NO_2 (1999/30/EC). The limit values (hourly and yearly) for the protection of human health must be reached by 1 January 2010.

Table: Future limit values for NO₂ coming into force on 1/1/2010 and alert threshold for NO₂ in 2001 (1999/30/EC)

HOURLY LIMIT VALUE for the	200 μg/m³ not to be exceeded more than 18 times a calendar
PROTECTION of HUMAN HEALTH	year
ANNUAL LIMIT VALUE for the PROTECTION of HUMAN HEALTH	40 μg/m³
ALERT THRESHOLD	400 μg/m³ over 3 consecutive hours

Ozone (O₃)

The European Directive 92/72/EEC describes the threshold values for the ozone concentrations in ambient air that apply for the protection of human health and for the protection of the vegetation. The table below gives a summary of the ozone threshold values for the protection of human health and vegetation.

Table: Ozone thresholds for the protection of human health and vegetation valid until 8/9/2003

INFORMATION THRESHOLD POPULATION	hourly average: 180 μg/m³
ALARM THRESHOLD POPULATION	hourly average: 360 μg/m ³
HEALTH POPULATION	8-hours average: 110 μg/m³ (*)
VEGETATION	hourly average: 200 μg/m ³
	daily average: 65 μg/m ³

The following table gives the target values and the long-term objectives for ozone not only for the protection of human health but also for the protection of vegetation.

Table: Target values and long term objectives (LTO) ozone for the protection of human health and vegetation to be respected in 2010 and 2020

TARGET VALUE for the PROTECTION of HEALTH	Maximum daily 8-hour mean : 120 μg/m³ not to be exceeded on more than 25 days per calendar year averaged over three years
TARGET VALUE for the PROTECTION of VEGETATION	AOT40, calculated from 1h values from May to July : 18.000 µg/m³.h averaged over 5 years (*)
Long term objective for the PROTECTION of HUMAN HEALTH	Maximum daily 8-hour mean within a calendar year: 120 µg/m³ in 2020 (target date)
Long term objective for the PROTECTION of VEGETATION	AOT40: calculated from 1h values from May to July : 6 000 µg/m³.h in 2020 (target date) (*)

(*) AOT40 (expressed in $(\mu g/m^3)$.hour means the sum of the difference between hourly concentrations greater than 80 $\mu g/m^3$ (=40 ppb) and 80 $\mu g/m^3$ over a given period using only the 1 hour values measured between 8:00 and 20:00 Central European Time each day.

This table shows the information and alert thresholds for ozone.

Table: Information and alert thresholds for ozone from 9/9/2003

INFORMATION THRESHOLD	Hourly average : 180 μg/m ³
ALERT THRESHOLD	Hourly average : 240 μg/m³ (*)

^(*) If the threshold value is exceeded during 3 consecutive hours short term actions should be developed

Carbon monoxide (CO)

The second Daughter Directive 2000/69/EG gives a limit value for the protection of human health for CO. Table 2.8. shows the future limit value for CO. This limit value for the protection of human health needs to be reached by 1st January 2005. A margin of tolerance has also to be applied. It amounts to 6 mg/m³ from 13/12/2000 to 31/12/2002. It decreases linearly from 1st January 2003 in order to reach 0% by 1/1/2005.

Table: Future limit value for CO coming into force on 01/01/2005 (2000/69/EC)

LIMIT VALUE for the PROTECTION of	10 mg/m³ as a maximum daily 8-hour mean
HUMAN HEALTH	To mg/m ² as a maximum dany 8-nour mean

Heavy metals

The first Daughter Directive (1999/30/EC) gives a limit value for lead (Pb). The margin of tolerance for Pb was set at 100 % at the entry into force of that Directive (19th July 1999). The margin of tolerance decreases linearly from 1/1/2001 to 0% at the date where the limit value must be reached (1/1/2005). The fourth Daughter Directive has been approved and published. Non-mandatory target values are proposed for arsenic (As), cadmium (Cd) and Nickel (Ni). Underneath table shows the future limit value for Pb and the proposed target values for As, Cd and Ni.

Table: Future limit value for Pb coming into force on 01/01/2005 (1999/30/EC) and proposed target values for As, Cd and Ni

Pb: LIMIT VALUE for the PROTECTION of HUMAN HEALTH	annual average: 500 ng/m³ (PM10 fraction)
As: TARGET VALUE	annual average: 6 ng/m³ (PM10 fraction)
Cd: TARGET VALUE	annual average: 5 ng/m³ (PM10 fraction)
Ni: TARGET VALUE	annual average: 20 ng/m³ (PM10 fraction)

Volatile organic compounds (VOC): Benzene

The second Daughter Directive 2000/69/EG gives a limit value for the protection of human health for benzene. Table 2.10. shows the future limit value for benzene. This limit value for the protection of human health needs to be reached by 1st January 2010. A margin of tolerance has also to be applied. It amounts to $5 \mu g/m^3$ from 13/12/2000 to 31/12/2005. It decreases linearly from 1st January 2006 in order to reach 0% by 1/1/2010. In Flanders the target date for respecting the limit value has been brought back to 1st January 2005.

Table: Future limit value for benzene coming into force on 01/01/2010 (2000/69/EC)

LIMIT VALUE for the PROTECTION	5 μg/m³
of HUMAN HEALTH	э дулг

Poly-aromatic hydrocarbons (PAH): Benzo(a)pyrene

A proposal for the fourth Daughter Directive is being discussed on the moment. A non-mandatory target value is also proposed for benzo(a)pyrene. The following table shows the proposed target value.

TARGET VALUE	annual average: 1 ng/m³ (PM10 fraction)

Dioxins and PCBs

The WHO proposes a tolerable daily intake (TDI) of 1 to 4 pg TEQ per kg bodyweight. A chain model was used to establish the relationship between the TDI and guide values for deposition. The proposed guide values for dioxin deposition are summarised in the next table.

Table: WHO-TEF of PCDDs and PCDFs

	Allowed deposition	
On a monthly basis	Appreciation	On a yearly basis
≤6 pg TEQ/m².d	Not increased	≤2 pg TEQ/m².d
> 6 pg TEQ/m ² .d	Moderately increased	> 2 pg TEQ/m².d
> 26 pg TEQ/m².d	Increased	> 10 pg TEQ/m².d

No guidelines for PCBs have been calculated. Meanwhile the target values for dioxin deposition are used to assess the deposition of PCB126.

2.1.5 Data

Some of the pollutants are not retained in the database, since they were only measured on a project basis (action 2). The description of them is retained because they are discussed in chapter 3.

Data on the following pollutants are given in the database: PM10, PM2,5 (all PM-stations of Flanders), SO2, NOX en O3 (of the stations 44N050, 44M705, 40OB01 and 44N029).

2-2. Aerosol remote sensing

2-2-1. Fundamental basis

a) Basic knowledge in atmospheric optics

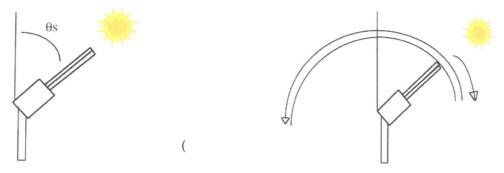


Figure 2.2.1: The two fundamental optical measurements: the direct measurement of the sun irradiance on the left and the diffuse measurement of the sky radiance on the right

The solar zenith angle is θ_s . A radiometer at the top of the atmosphere (TOA) measures the solar irradiance E_s (in w/m²/µm) at different wavelengths. If the radiometer is installed at the ground level, E_s is reduced by the scattering and absorption processes through the atmospheric path. The solar irradiance E at ground level is

$$E = E_s \cdot e^{-m \cdot \tau} \tag{2.2.1}$$

The air mass m=1/cos (θ_s) describes the length of the atmospheric path and the key parameter is the optical thickness τ .

When not aiming the sun, the same radiometer measures the sky radiance L which directly results from the scattering by the molecules and by the aerosols. L is proportional to τ and to the phase function P which varies with the scattering angle (angle between the incident direction and the view direction). From space, if the Earth surface is black, we can also measure the sky radiance.

Both E and L provide information on the aerosols after removal of the molecular contributions. Molecular scattering and absorption are well known and only depend upon the barometric pressure at the surface. Increases of both correspond to an increase of the aerosol loading. The spectral dependence of E and L (the colour of the aerosols) give some information on the aerosol size.

b) The physics of the satellite signal

The Earth reflects towards space a fraction of the solar incident light. In one given direction, satellite sensors observe this radiation (radiance in w/m²/sr) reflected by the atmosphere-surface system in the spectral domain from the blue (412 nm) to the near infra red (865 nm).

From space, we can see the aerosols particularly during strong dust episodes. It is the case of Saharan aerosols across the Mediterranean Sea and over the Atlantic Ocean. But, it can be as well the case for local air pollution as it is illustrated in figure 2.2.2.



Figure 2.2.2: On this SeaWiFS image, acquired on September 3, 1999 over the Strait of Dover, we clearly see an aerosol plume crossing the Strait of Dover.

We can see the aerosol because they scatter the incident solar light differently from the molecules. The blue colour of the sky comes from the molecular scattering while the aerosol scattering is whiter. We define the reflectance ρ (in percent) as the ratio between the reflected energy to the incident energy.

The molecular reflectance ρ_m sharply decreases from the blue ($\rho_m \cong 10\%$) to the near infra red ($\rho_m \cong 0.7\%$). Complementary, for a standard visibility of 23 km, we have an aerosol reflectance ρ_a of 2%.

The space observation is facilitated above dark surfaces. The water is dark in the red and the near infra red. The aerosol component is currently measured in two spectral bands (one in the red at 670 nm and one in the infra red at 865 nm). Over land, as illustrated in figure 2.2.3, the surfaces are generally bright and then the aerosol contribution is vanishing. One noticeable exception is for the dense dark vegetation (DDV) for which the chlorophyll strongly absorbs the light in the blue (443 nm) and in the red (670 nm) for photosynthesis. We then have dark targets on which again we can have access to ρ_a . This DDV is easily detectable based on the important gradient in reflectance between the red and the near infra red.

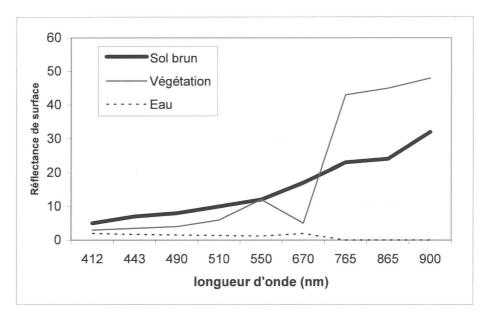


Figure 2.2.3: Typical surface reflectances versus wavelength: water (dashed line), vegetation (full line) and bare soil (full bold line).

To summarize, we can get the aerosol reflectances in two spectral bands in which the surface is dark:

- (i) Every where over water in the red and in the near infra red.
- (ii) Over land, locally above dense dark vegetation (forests and dense green canopies).

Another clear limitation is the need to have clear sky conditions. Figure 2.2.4 gives a statistic of clear sky conditions for year 1999 over Boulogne Sur Mer. SeaWiFS was used daily and clear sky corresponds here to less than 10 percent cloud cover in a 100 km by 100 km window centred over Boulogne Sur Mer. This histogram clearly indicates that the Earth Observation can not be by itself an operational tool for air quality monitoring.

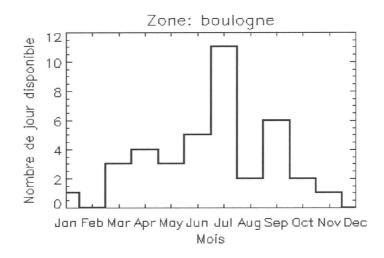


Figure 2.2.4: Number of clear day every month of year 1999

c) The SeaWiFS sensor

Table 2.1.1 gives the main characteristics of the SeaWiFS sensor. SeaWiFS is on a sun-synchronous platform (overpass time is around noon) on a polar orbit. It views a given pixel of about one km by one km size, every day (some time twice a day). It is operational since 1998 and data are sent monthly by NASA free of charge as far as no commercial uses are done with the data.

SeaWiFS is an ocean colour sensor. The use of the ocean colour to derive the water content (mainly in chlorophyll a) requires performing atmospheric correction for which the aerosol model is a key parameter. The aerosols are remote sensed over water using spectral bands 6 and 8. Over land, we have the required band setting to see the aerosols over DDV (at 412, 443 and 670 nm).

d) From the aerosol optical properties to the PM

We now have the aerosol reflectances at two wavelengths from which we want to derive the mass concentration of particles having a smaller diameter than 10 μ m (PM10) or 2.5 μ m (PM2.5). In principal, under a set of assumptions, it is possible to formally associate the two quantities if:

- (i) The aerosol are spherical (simplify the optical theory),
- (ii) They are identical in the atmospheric column.
- (iii) We know the vertical distribution of the total abundance (convert optical characterization of the atmospheric column into PM at ground level),
- (iv) We know they chemical composition (refractive index required) and they density (transform number of particles into mass),
- (v) We assume a size distribution law n(r).

All above defined, we can in principle convert the aerosol reflectances into PM.

2-2-2 The SeaWiFs like algorithm over water

The SeaWiFS data are processed with a standard software package distributed by NASA: Seadas. Within Seadas exists a routine devoted to the aerosol remote sensing following the technique proposed by *Gordon and Wang (1994)*. The basis of this are:

- (i) the red and infrared spectral bands are used because the water is dark.
- (ii) the aerosol path radiances ρ_a are extracted from the TOA radiances after correction from the gaseous absorption and from the molecular scattering.
- (iii) the spectral dependence of ρ_a is used to select an aerosol model among a set of standard models.
 - (iv) knowing the aerosol model and the corresponding phase function, the aerosol optical thickness (AOT) is derived from ρ_a .

The outputs of SeaDAS is the aerosol optical thickness τ_a at 550 nm. This satellite aerosol product has to be converted into PM₁₀, PM_{2.5}. We quantify here what we introduced in section 2.2.1.c. The aerosol vertical distribution n(r, z) is assumed to be exponential:

$$n(r,z) = n(r,0)\exp(-\frac{z}{H_a})$$
 (2.2.2)

 H_a is the aerosols vertical scale height (m).

The formulation of the PMx is:

$$PM_{X}(z=0) = \frac{4}{3}\pi d \frac{\tau_{a}^{550}}{H_{a}\Sigma_{scg}^{550}(n(r))} \int_{0}^{X/2} r^{3}n(r)dr$$
 (2.2.3)

Where d is particle density ($\mu g.m^{-3}$), Σ_{sca} (m^{-1}) is the aerosols scattering coefficient at 550 nm and n(r) is aerosols size distribution. Σ_{sca} is computed using the Mie theory as soon as we know n(r) and the particle refractive index. The atmospheric correction algorithm does not return any aerosol model. The continental model is used by default. So, under some assumptions on d (d = 16.6 $\mu g.m^{-3}$) and H_a (H_a =2 km), we get PM_{10} :

$$PM_{10} \approx 144.\tau_a^{550} \tag{2.2.4}$$

SENSOR NAME: SeaWiFS Special feature(s): 1			Platform name: Sea	star Form: 18		
	Radiometer na	ame: SeaWiFS		Temporal	coverage: 1 day	
Radio	neter type :					
• Scan	ning radiometer					
• 8 cha	nnels					
Mode	characteristics					
			Swath width		Spatial resol.	
			(FOV)		(Nb pixel/line)	
			2800 km		1.13 km	
			(± 20°)			
	els characterist					
Band	Band centre	Bandwidth	Polarisers	$NE\Delta L$		
Nr	(µm)	(µm)		$(W.m^2.sr^{-1}.\mu m^{-1})$)	
1	0.412			0.092		
2	0.443			0.077		
3	0.490	0.00		0.056		
4	0.510	0.02		0.049		
5	0.555		No	0.043		
6	0.670			0.031		
7	0.765	0.04		0.019		
8	0.865			0.015		

FOV Field Of View

General description

The Sea viewing Wide Field of view Sensor SeaWiFS is a scanning radiometer with eight spectral bands in the visible and near infrared spectral region. Although SeaWiFS is an ocean colour sensor, a bilinear response gain allows retrieving data also above bright surfaces. Specular sun reflection by the ocean is avoided by tilting perpendicularly to the scan plane the entire instrument. The ground resolution is 1.13km at nadir and the swath width is 2800km. A daily global coverage can be provided.

Table 2.2.1: the main characteristics of the SeaWiFS sensor

2-2-3. Initial MERIS like algorithm over land

This algorithm, previously defined for the MERIS sensor on ENVISAT (Santer et al., 1999; Ramon and Santer, 2001) has been adapted for this project to SeaWiFS data. The general process in figure 2.2.5 described the determination of the aerosol model over the specific pixels that are the DDV.

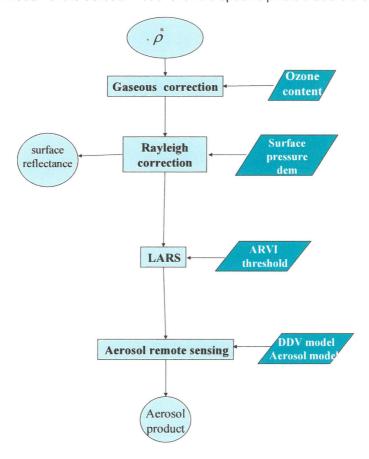


Figure 2.2.5: the general flow chart for aerosol remote sensing over land

Starting from the top of atmosphere reflectance ρ^* , the first module performs the gaseous correction (gas) with the ozone content as auxiliary data. Auxiliary data are the surface pressure at sea level and a digital elevation map (DEM) to account for the elevation to get the actual surface pressure. The apparent reflectance, corrected from the gaseous absorption, ρ_{na}^* , is then corrected from the Rayleigh scattering (rayleigh). Then, pixels suitable for aerosol remote sensing, DDV pixels, are selected as Land Aerosol Remote Sensing (LARS) based on the used of the Atmospheric Resistant Vegetation Index (ARVI) to select them. The last module applies on these pixels to remote sense (aerosol) the aerosols. The output is the aerosol optical thickness at 550 nm and the same conversion into PM than above is applied.

The analysis of the MERIS imagery clearly illustrated the limitation of a technique solely based of the presence of DDV pixels: during winter, we do not detect any dense dark vegetation. Illustration is given in figure 2.2.6 for a MERIS scene collected on 3/12/2003 for which we provided the AOT at 865 nm. The aerosol product exists over water but not over land.

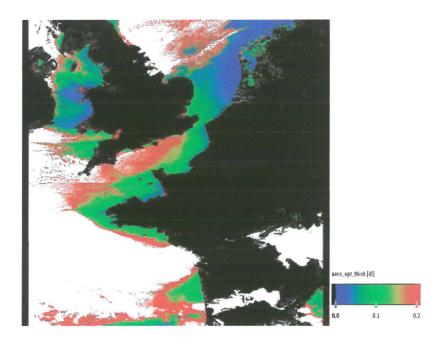


Figure 2.2.6: AOT at 865 nm as derived from MERIS on December 3, 2003; first processing

2-2-4. Consolidated MERIS like algorithm

The first MERIS processing has shown the weak coverage of DDV targets. This lack of cover has been already shown on MOS (*Borde et al., 2003*) and on SeaWiFS (*Vidot et al., 2003*). An important effort has been realized to extend the DDV concept to brighter surfaces. For that, the ARVI threshold is decreased and a linear relation between this ARVI decreasing and the surface reflectance in the blue and in the red is proposed. This behavior is illustrated in figure 2.2.7. On the x-axis, only the pixel with ΔARVI>0 where considered in the first processing. The linear regression can be applied when decreasing the ARVI by 0.5 which allow including a significant number of new pixels. A full description of the surface reflectance model used for the MERIS aerosol remote sensing module is given in *Santer et al., 2004*.

The second MERIS reprocessing includes these new pixels for aerosol remote sensing and the improvement in terms of spatial coverage is illustrated in figure 2.2.8. In EXPER/PF, we implemented this new MERIS algorithm to process SeaWiFS.

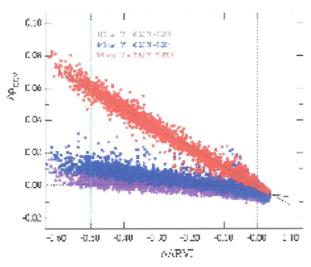


Figure 2.2.7: Difference between retrieved ground reflectance and DDV reflectance stored in the Look Up Tables (ΔρDDV) as a function of the difference between the ARVI and the ARVI threshold used for DDV detection (ΔARVI)

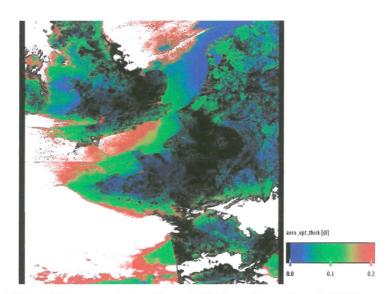


Figure 2.2.8: AOT at 865 nm as derived from MERIS on December, 3, 2003; second processing

2-2-5. Last improvements in the aerosol component retrieval

Remove the pixels in the vicinity of clouds

In the vicinity of clouds, the solar light reflected by the clouds is and additional white source. This stry light does not affect significantly the spectral signature of DDV. Such DDV pixels in the vicinity of clouds are then used to remote sense the aerosols. Because of the additional contribution of stray ligth, the application of the aerosol retrieval scheme to these contaminated pixels gives high values of the AOT. Figure 2.2.9 gives an example of such over estimation of the OAT in the adjacency of the clouds. Values as high as 1 are displayed near the cloud desk while minimun AOT values of 0.2 are observed in clear areas.

In the new EXPER/PF process a cloud vicinity mask is applied which eliminate pixels closer to ?? km.

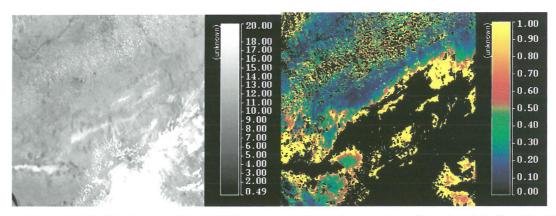


Figure 2.2.9: Black and white MERIS images indicate the location of the clouds(left) while AOT at 865 nm illustrates the AOT overestimate in the cloud vicinity.

2-2-6. Validation of the satellite product

a) Validation of the AOT

Figure 2.2.10 informs about the ground based network of optical measurements. CIMEL instruments measure continuously on a routine basis the AOTs at 440 nm, 670 nm and 870 nm. Figure 2.2.11 gives an example of such measurements of the AOT at 440 nm for a time periods in 2003. The spatial homogeneity is quite good between the three locations which implies than these CIMEL measurements can be compared to averaged values of AOTs derived from satellite.

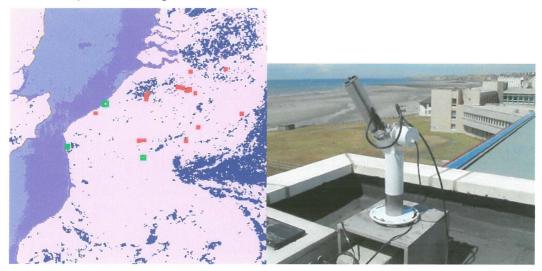


Figure 2.2.10: CIMEL sun photometers (see right) are implemented in our region (see red dots on the map on left) to measure the AOTs.

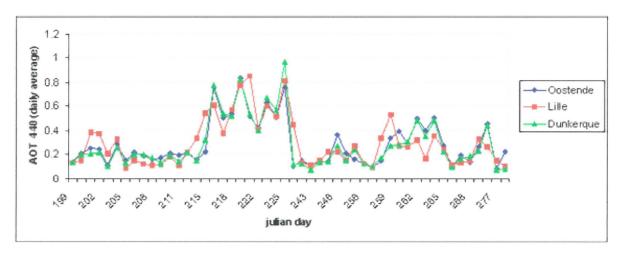


Figure 2.2.11: CIMEL AOTs at 440 nm versus time in year 2003 collected in the sun photometers network.

The SeaWiFS products, generated in the expert PM data base, were used for validation. The CIMEL station in Lille offered the largest data set and then was used for validation. The SeaWiFS AOTs, provided at 440 nm, 670 nm and 865 nm, were averaged on a window centred around lille but with different sizes. A minimum number of nine LARS pixels should be recorded in the window before averaging the AOTs. The CIMEL AOTs were chosen at the nearest time to the SeaWiFS time of overpass. Figure 2.2.12 reports the comparison between the two data sets. When the size of the window increases, more pixels are involved and therefore more comparisons are available. On the other hand, the average is less representative in a comparison to a local CIMEL measurement. Let us take a window size of 10 km. What we see on the second row of 2.2.12 is that the SeaWiFS AOTs are slightly underestimated at 440 nm and slightly overestimated at 670 nm. The reference wavelength in the conversion AOT and PM is 550 nm (see Eq. 2.2.3). Accordingly, we believe that the AOTs we derived at 550 nm are validated through this comparison.

b) Validation of the PM

Through Eq. 2.2.4, we reach the final objective which is to get PM10 (or PM2.5) from the satellite. The key issue we cover here is the comparison between the two data sets of PM10: from the air quality network and from satellite (actually we need to apply a scaling factor of 144 to convert AOT_550 into PM10). This comparison was done for all the PM stations on a daily averaged value. Results are reported in figure 2.2.13 for different stations. Sometimes there are correlations, sometimes not!

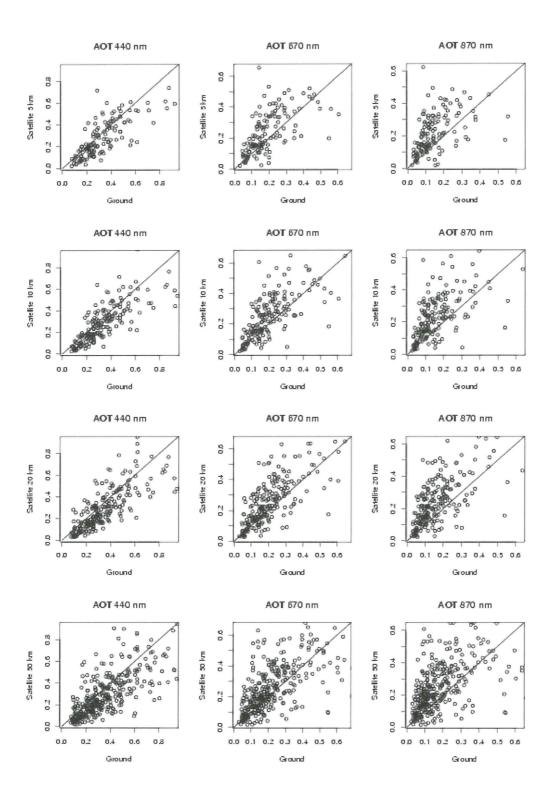


Figure 2.2.12: AOT at three wavelengths (440 nm, 670 nm and 865 nm) in Lille. CIMEL values are in x-axis while satellite derived values are given (y-axis) as averaged values on 5, 1, 20 and 50 km.

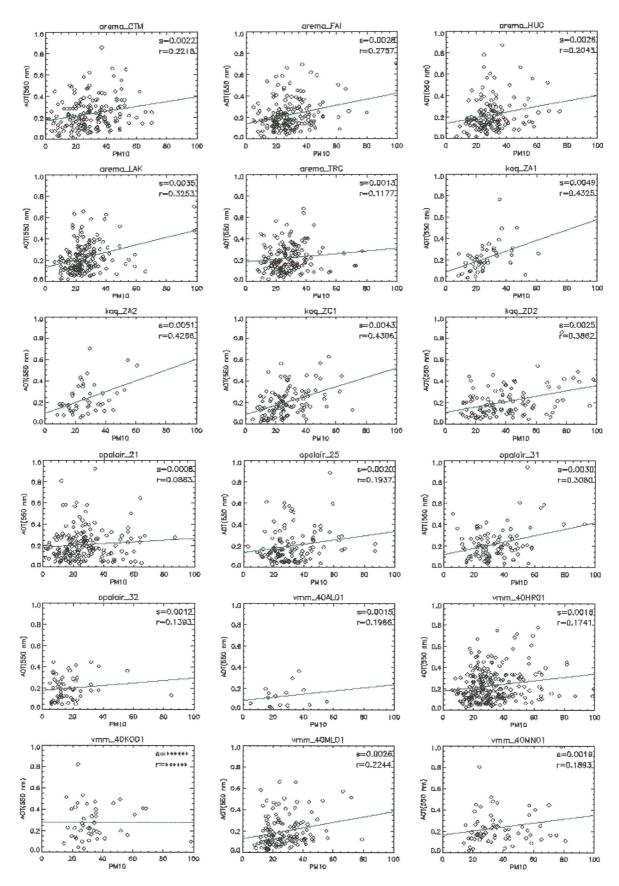


Figure 2.2.13: PM10 measurements versus satellite derived AOT.

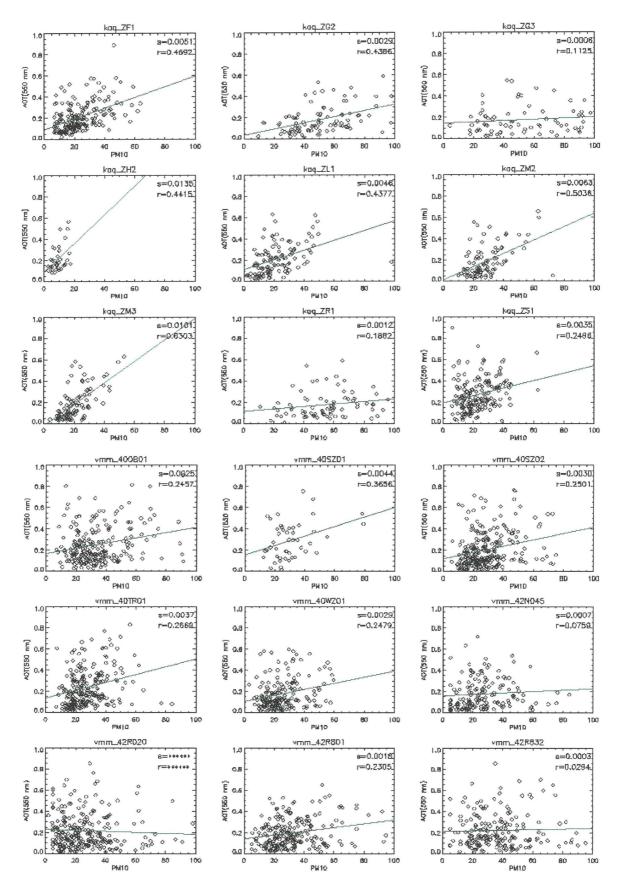


Figure 2.2.13: PM10 measurements versus satellite derived AOT (continued).

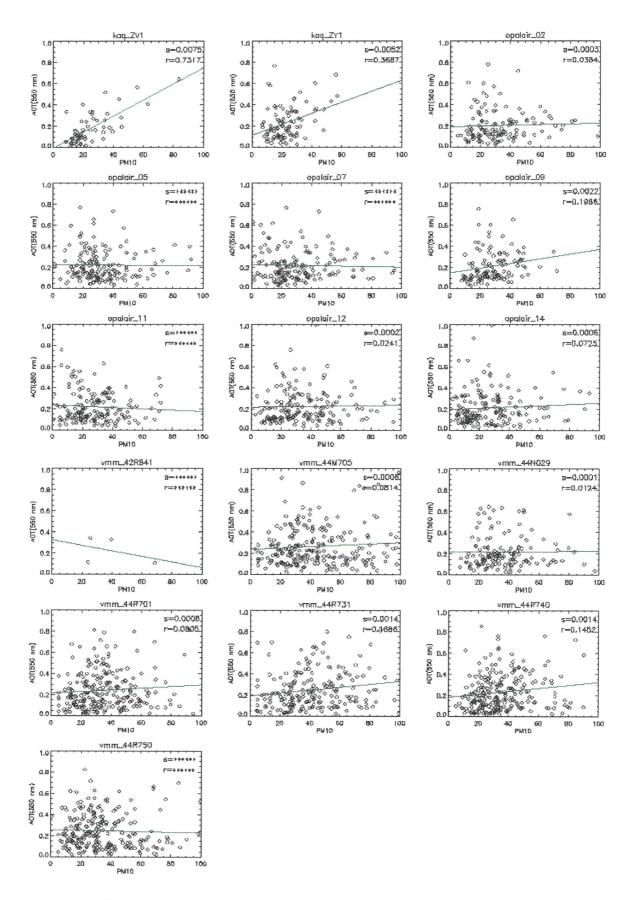


Figure 2.2.13: PM10 measurements versus satellite derived AOT (continued).

2-2-7 Remaining issues

Yes we get AOTs from satellite. It is useful by itself first over the ocean, for which the AOTs are provided for each pixel, to identify local dust episodes crossing the Channel or over the North Sea. It is usefull as well to use satellite pictures at a large scale to identify large dust outbreaks, such as Saharan dust storms. Over land, we have access to the rural background of the AOTs.

There is still room to improve the aerosol remote sensing. The spectral dependence of the AOTs gives the colour of the aerosols directly related to the size. But, at this stage, the major issue is to establish a "good" relation ship between AOT and PM. The set of Eqs. 2.2.2 to 2.2.4 illustrates than mainly parameters are involved and most of then are not accessible or known. What we realized from figure 2.2.12 is that there is not real possibility to directly correlate AOT and PM. Then, we need to introduce auxiliary parameters to investigate this AOT-PM relationship. What are these auxiliary parameters: the date (useful information about the seasonal features) and certainly more important are the meteorological data.

We will taken advantage of ATTMA (a UK-French interreg3a project) to resume these activities.

2-2-8 References

Borde R., et al., "Extension of the DDV concept to retrieve aerosol properties over land from the Modular Optoelectronic Scanner sensor", *International Journal of Remote Sensing*, Vol. 24, 1439-1467, 2003.

H. R. Gordon, and M. Wang, "Retrieval of water-leaving radiances and aerosol optical thickness over the oceans with SeaWiFS: a preliminary algorithm", Appl. Opt. 33, (3), 443-452, 1994.

Santer R., et al., A surface reflectance model for aerosol remote sensing over land, ENVISAT workshop in Salzburg, September 2004, ESA proceedings.

Ramon, D. and Santer R., Operational remote sensing of aerosols over land to account for directional effects, *Applied Optics*, Vol. 40, 3060-3075, 2001.

Santer R., et al., Atmospheric corrections over land for MERIS, *International Journal of Remote Sensing*, Vol. 20, 1819-1840, 1999.

Vidot J. and R. Santer, SeaWiFS level 3 products over land, Remote sensing of Clouds and the Atmosphere VIII, Eds. K. P. Schäfer, A. Comeròn, M. R. Carleer, R. H. Picard, *Proc. of SPIE* Vol. 5235, 357-365, 9-12 September 2003, Barcelona, Spain.

2-3. The data base.

We give an overview of the prototype web service developed during EXPER-PF that deals with particulate matter (PM₁₀ and PM_{2.5}) monitoring. It consists mainly of a cross-border database that includes air quality networks data, SeaWIFS and MERIS aerosol derived maps. We show potential applications like network comparisons and trans- boundary transport, air quality model validation as well as satellite product calibration.

2-3.1 Objectives

Project's primary objective was to develop and promote a cross-border database on atmospheric Particulate Matter, usable by the professionals involved in Public Health, Environment and Regional Planning and also in Research in Air Quality Modelling. The area of interest of the project is given in *Figure 2.3.1*.

A secondary objective was to provide information for estimating those ambient PM levels by relating remotely measured, vertically integrated aerosol optical data derived from Earth Observation to mass measurements made by ground based monitoring networks. Numerous studies have shown the relationship between aerosol scattering and fine particles mass (PM_{2.5}). Thus we merged aerosol optical thickness maps derived from optical medium resolution sensors with meteorological and climatological data in order to estimate the population background exposure to PM over large areas. In the context of GMES, it was also an opportunity to demonstrate the usefulness of such integrated tools merging in-situ and EO data for validating air quality models.



Figure 2.3.1: EXPER/PF zone with main cities (white dots) and PM monitoring stations of the air quality networks (coloured dots)

2-3.2 Data processing

Air quality data

Four air quality networks took part in the development of this data base: AREMA LM, OPAL'AIR and VMM of the EXPER-PF project and also the Kent Air Quality network within a side project called ATTMA

(Aerosol Transport over Trans Manche Area) involving the UK. The raw measurements are supplied on a **half hourly** basis and include the following data:

- PM₁₀ et PM_{2.5},
- Some gaseous compounds (CO, SO₂, NOx, O₃...),
- Meteorological data: wind speed, atmospheric pressure, relative humidity, for some stations.

They are inserted automatically into the database at HYGEOS after delivery by the air quality networks:

- in real time with ftp protocol for VMM,
- off line for other networks.

The data are averaged before insertion into the database to obtain hourly, daily and monthly data.

Earth Observation data

The database consists mainly of level L1B SeaWIFS images acquired by the Dundee University Receiving Station in HRPT format and obtained trough the DAAC since 1998. Basically two images per day are processed over the region of interest shown in *Figure 2.3.1*. The main steps for the production of PM maps are described in *Figure 2.3.3*. Over ocean we process the pixels with the original algorithm developed for SeaDAS. Over land, we adapted the level 2 MERIS algorithm yielding the Aerosol Optical Thickness (AOT) over dark vegetation, recently extended to brighter targets (*see chapter 2-2.*). Finally we converted AOT into PM₁₀ concentrations using several assumptions like a fix aerosol model and exponential decrease of the aerosol concentration with altitude. Several MERIS images are also progressively included in order to show the potential improvements we may expect from this sensor (spatial resolution, better cloud filtering with the oxygen channel, etc...). The set of satellite data available may be visualized with an online catalogue. An example of output of this catalogue is shown in *Figure 2.3.2*.

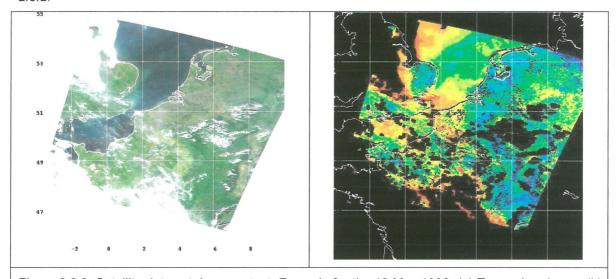
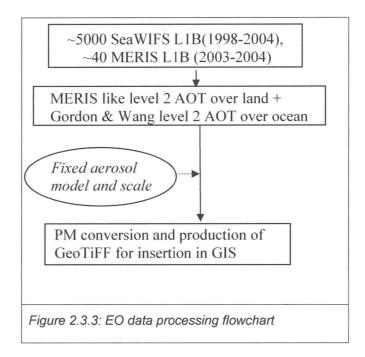


Figure 2.3.2: Satellite data catalogue output. Example for the 13 May 1998: (a) True colour image (b) PM_{10} concentration map.



Interface

Start

The first thing is to authenticate with a login and a password. Then the main page appears. The main page is the starting point to make request for both time series of air quality networks data (*Figure 2.3.4*), and either in situ and satellite data (satellite data catalogue). For a particular day, one can have a snapshot of the pollution level in the region with the mapping tool (*Figure 2.3.5*). French, English and Netherlands flags allows one to switch to the different languages of the site.

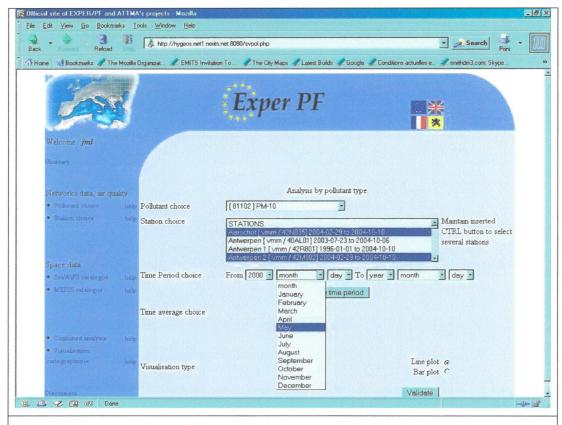


Figure 2.3.4: Time series interface

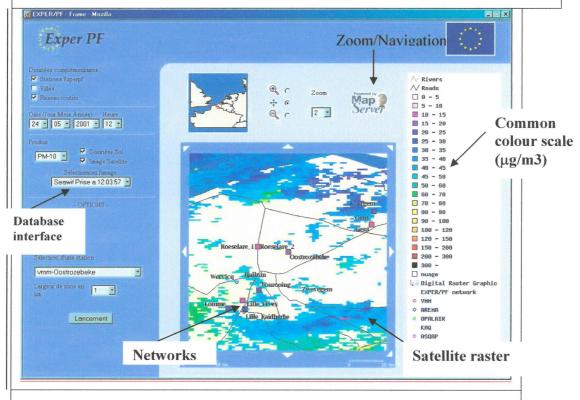
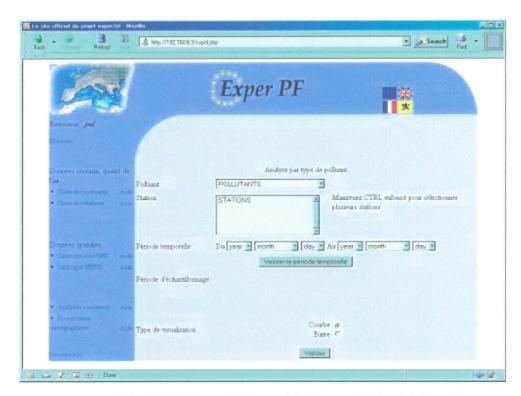


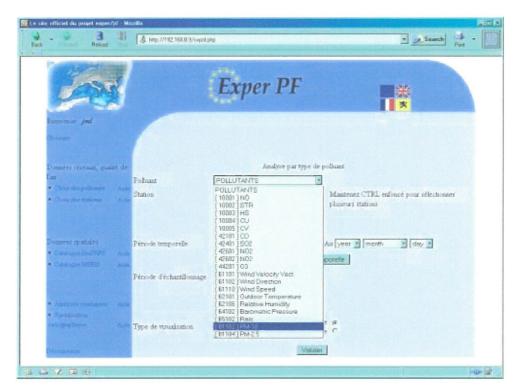
Figure 2.3.5: Mapping Interface

Time series

Here is an overview of the functionalities of the air quality time series query interface.

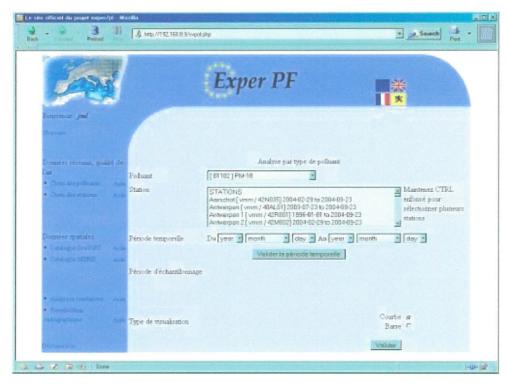


Clicking on "Pollutant choice" appears the main menu giving access to the database.



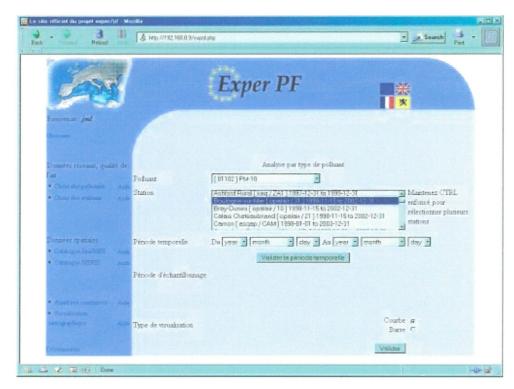
Select a pollutant (here PM₁₀). Each line correspond to a pollutant characterized by:

- Its code.
- Its name or abbreviation.

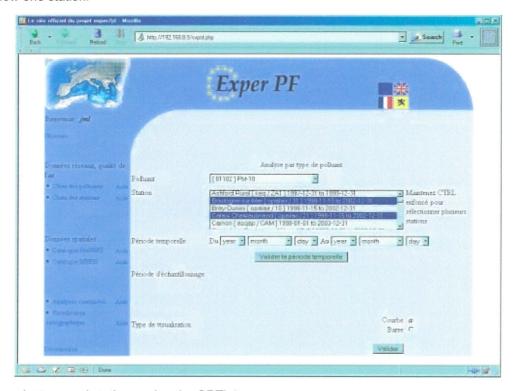


Then appears the list of sites which have measured this pollutant. Each line consists of:

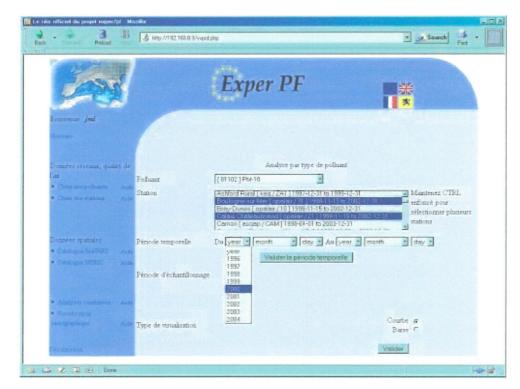
- The name of the town where the measurement station is located in
- The name of the air quality network owning the station
- The identification code of the station
- The date of the first available measurement for that pollutant.
- The date of the last available measurement for that pollutant.



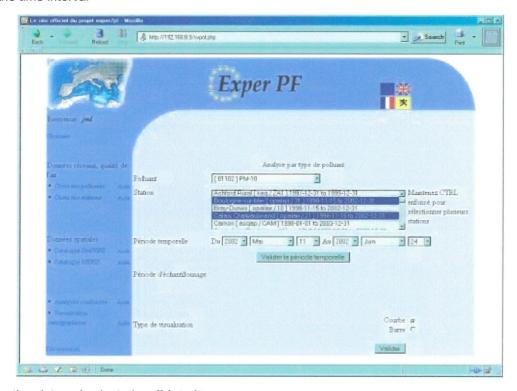
Select now one station.



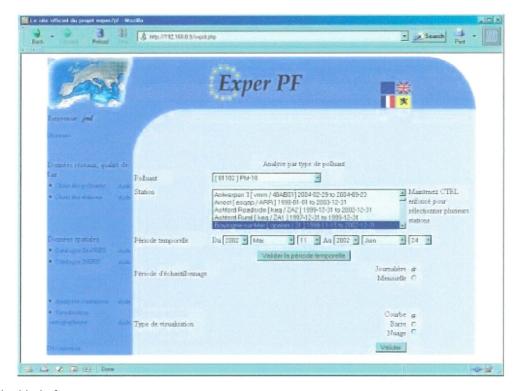
You may select several stations using the CRTL keys



Select the time interval



Once the time interval selected, validate it.

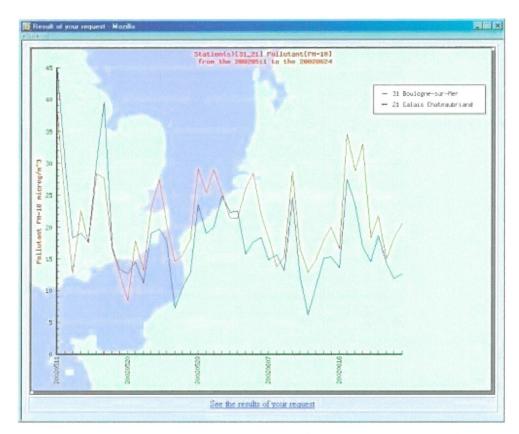


Select the kind of average:

- Hourly
- Daily
- Monthly



Then Select the Visualization Type: Curve, Bar, Scatter.



Click on the graph symbol and the plot appears. It consists of a graph and a link "See the results of your request"

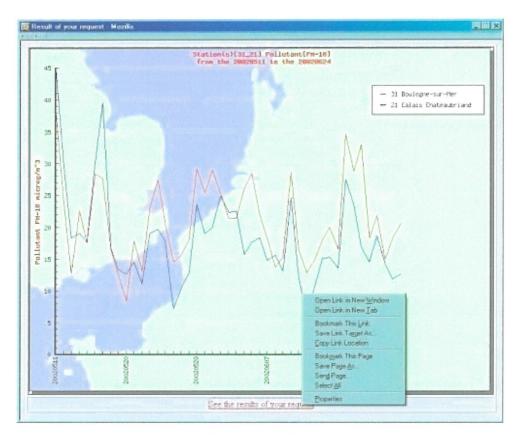
The graph:

Y axis : pollutant concentration

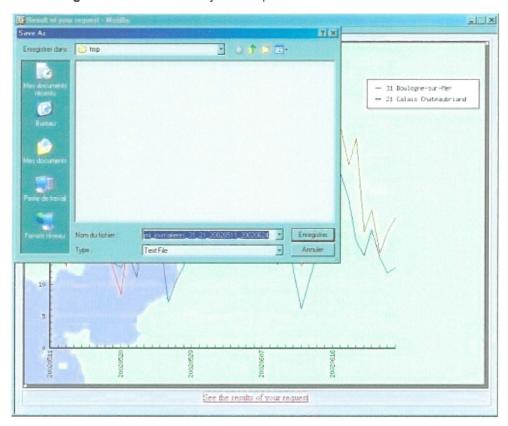
X axis: time

Legend describing each measurement station

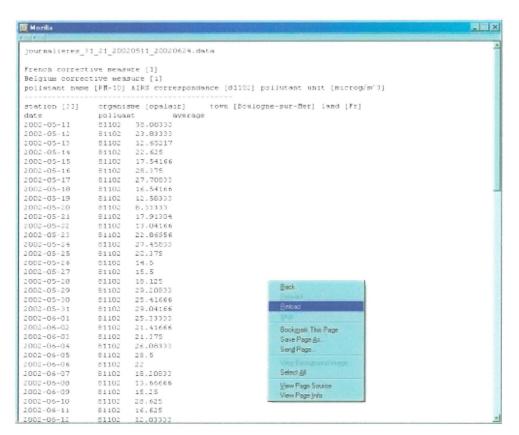
• A title in the top centre summarizing your selection.



Right-clicking on the link "See the results of your request " you may download the data using in the menu Save Link Target as and save it onto your computer.



The name of the data file is already defined. It summarizes your selection. You can save it. Left-clicking on the link **See the results of your request**, you may see the data values.



The file content. To return to the graph window, right-click and select in the menu Back.

Map interface



Select "Mapping Interface" in the main page.



A new page appears. It's the mapping interface. Other pages like this can be open at the same time from the main page.

On the left, we have the interface with the data base in the middle and a menu to select the area of interest at the bottom. At the top, you may select various auxiliary data sets (points and polygons) to be

permanently displayed on the map.

On the right, we have the map itself with its navigation/zoom interface.



Indicate the date and time.

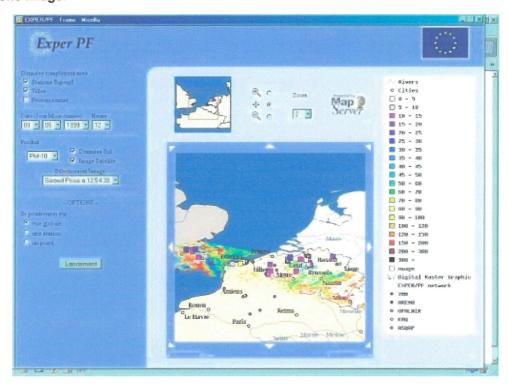


Select the **pollutant** you want to map. For PM_{10} you have also the choice to select **satellite** data.



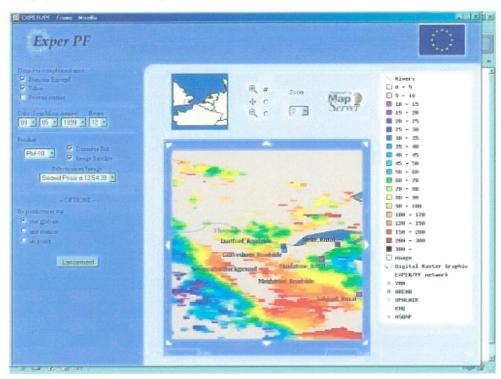
If you have chosen satellite data, a menu appears, listing all images available for that day, with the time of satellite overpass.

Select one image.

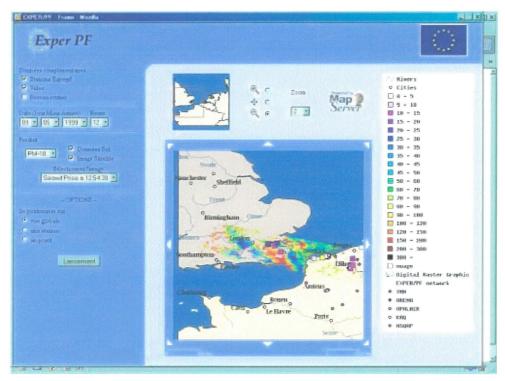


Push **Start** button. After few seconds, the map on the right is refreshed with the data selected. Ground data are represented by small squares centred into measurements stations of the different networks. Satellite images are super imposed. Both data are coded with the same colour scale indicated on the

right of the map (concentrations are given in μg/m³).

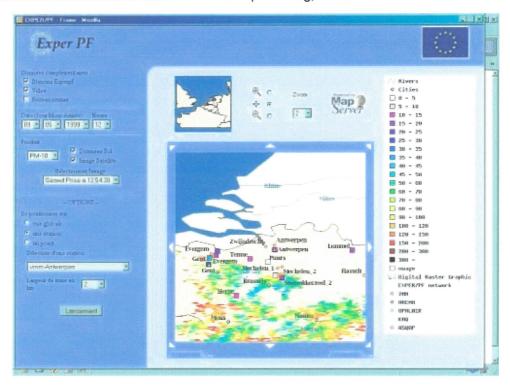


It is possible to **navigate** through the map and **zoom** in(+)/out(-). The small map at the top shows what is seen in the central square. You may click in this small map to directly look at a particular zone of interest.



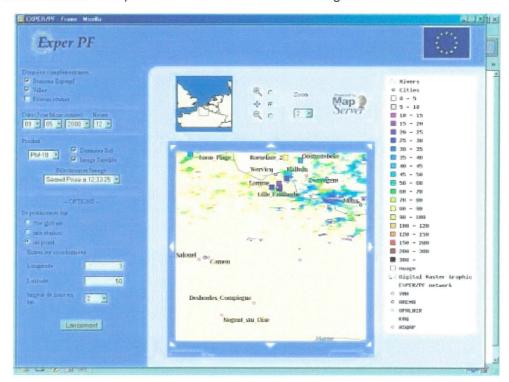
To zoom, first select the **zoom in tool (+)** or the **zoom out tool (-)**. Then select the **zoom factor** in the scrolling list. Finally left-click into the central map, where you want to zoom. After few seconds the map is refreshed. While the zoom in or zoom out tool is selected, each click on the map will provoke map

refreshment with increased/decreased zoom. To stop zooming, select the move tool in the centre.



You can specify directly a particular area of interest in the menu at the bottom left. You have the choice between:

- Global view (default)
- Station: centred into a particular station chosen in a scrolling list.



You may directly specify the geographical coordinates of the centre of the area of interest. Specify also

the **size** of the area in km. Finally push **Start** button to refresh the map. From now the area of interest will not change even if you chose another date or pollutant.

Applications of the tool

Network comparisons

 PM_{10} measurement protocol is still a matter of debate between French and Flemish agency, different corrective factor being recommended by the Belgian (around 1.3) and French agency. The situation is the same for $PM_{2.5}$ but with much less measurements stations. It is quite interesting in this context to use the database to compare PM measurements for both networks. Figure2.3.6 shows that absolute values of $PM_{2.5}$ are very similar at the scale of the euro region (~150 km) and that the concentration of fine particles, at least for monthly average are highly correlated. It confirms the interest to study particulate matter pollution also at the regional level to estimate contribution from the outer region to the background level.

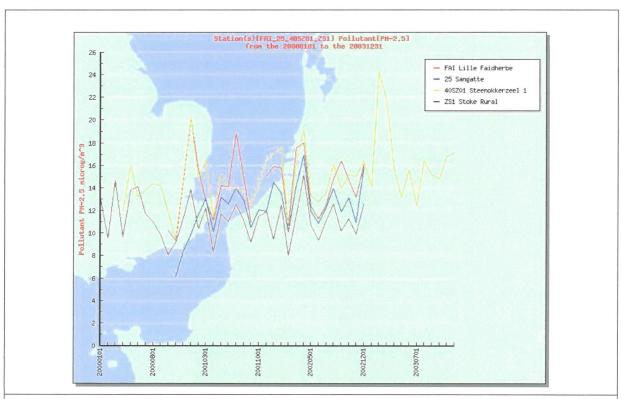


Figure 2.3.6: On-line time series extraction from the database: $PM_{2.5}$ monthly mean for Sangatte (blue, 50.95N 1.77 E), Lille (red, 50.62N 3.08E), Stoke (violet, 51.46N 0.63 E) and Steenokkerzeel (yellow, 50.91N 4.51E) sites for 2000-2003. Y axis ranges from 0 to 26 μ g.m⁻³

Calibration of satellite-in-situ PM relationship

We used the database to study the correlation between the satellite derived AOT and PM₁₀ measurements made by the networks. More details are given about this issue in **section 2.1**. An example for rural and background stations mainly located in the UK is given in *Figure 2.3.7*.

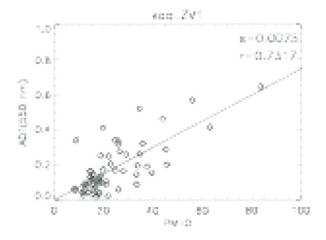


Figure 2.3.7: Correlation between PM_{10} ($\square g.m^3$) and AOT at 550 nm derived from SeaWiFS, averaged over a distance of 20 km around the Sevenoaks air quality station(UK, 51.29N 0.2E) for clear days in the period 1998-1999.

Support for pollution events analysis

Example

Among the period 1998-2004, there has been several pollution episodes documented both by ground data and satellite data, allowing to better characterise the dynamics of the episode. An example is given in *Figure 2.3.8*. High levels of PM10 were recorded on May 13rd, 1998 by all measurements stations in the euro-region but not at the same time. The satellite map reveals a very perturbed atmosphere with a highly variable pollutant field. When zooming along the French-Belgian border, wee see a pronounced front around 12 UT.

Perspectives

The tool may be improved with the inclusion of meteorological data (wind fields, humidity fields also back-trajectories) and dispersion model enabling rapid interpretation of pollution events. For example, we give in *Figure 2.3.10* the dispersion model HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory Model, see http://www.arl.noaa.gov/ready/hysplit4.html) iso concentration output for a simulation of a point source pollution episode as well as a MERIS image. It is possible to link the service with a PM forecast service like "Prev'air" for example (see http://prevair.ineris.fr/). Note that the colour scale of the Exper-pf maps is the same as prev'air maps still allowing direct comparisons. As it is, the tool is already useful for estimating background level of PM. Satellite derived maps may help estimating background PM levels and contribution from outside the region.

Conclusion

In particular with this web based tool, the project EXPER-PF has been able to demonstrate, at a regional level, some preliminary applications of the strategy of gathering ground data from different air quality networks and Earth Observation data. The project end now and wee are searching for continuing/expanding the service at the European level for either applications exploiting archive data (for public health studies for example) or real time data (air quality forecast).

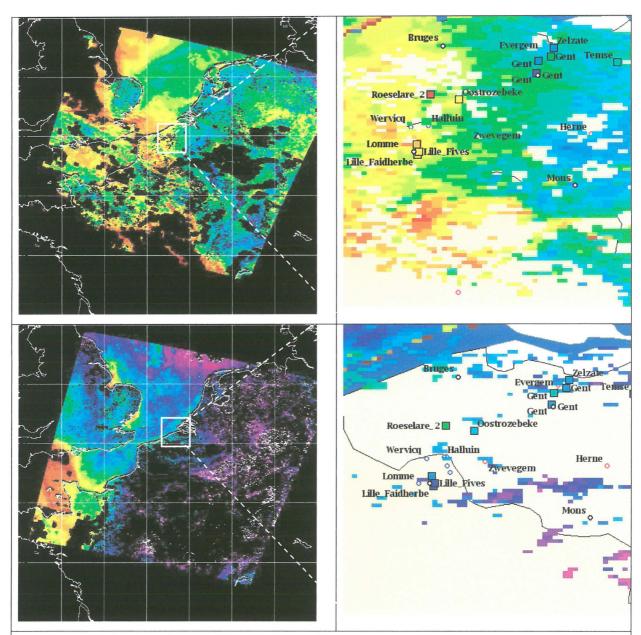


Figure 2.3.8: Pollution event (PM_{10} in $\mu g/m^3$, same colour scale as Figure 2.3.4) on 13 rd May 1998 (Top lef: for the whole euro region, Top right: around Lille with coincident air quality concentrations measured at 12 UT) to be compared to the day after (Bottom). On 13/05/98, PM concentration field is high and heterogeneous. On 14/05/98 it is quite uniform and level is standard.

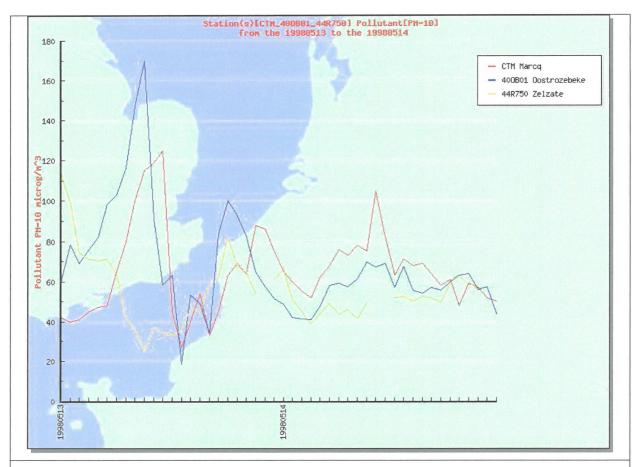


Figure 2.3.9: Hourly data PM_{10} pollution data on 13 and 14 of May 1998 for 3 stations: Marcq en Baroeul, Oostrozeebeke and Zelzate. Note the time delay of the peak arrival in Zelzate relative to Oostrozeebeke as confirmed in Figure 2.3.8.

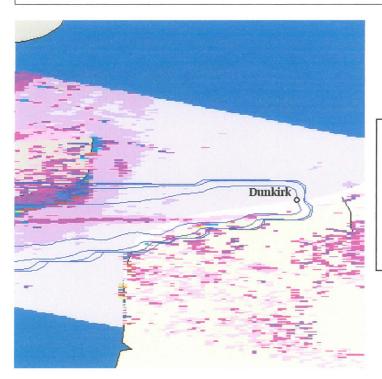


Figure 2.3.10: Plume detection by MERIS coming from industrial pole of Dunkerque across the English channel on 07/12/2003 and forward simulation of dispersion starting from Dunkerque as calculated by HYSPLIT model using AVN meteo data.

3. Action 2: Case study around the Lille area

A case study around the Lille area was realised by AREMA Lille Metropole (AREMA LM), the Flemish Environmental Agency (VMM) and the University of Antwerp (UA).

The emphasis of the study lays on the border area between the cities of Roeselare and Kortrijk in the Flemish province of West-Vlaanderen and the cities of Lille and Tourcoing in France. The studied area is given in the figure below.

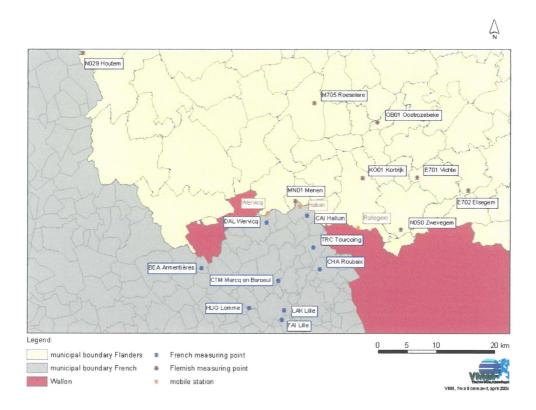


Figure 3.1: Map of the agglomeration of Lille and nearer part of Flanders with situation of the fixed stations

3.1 Campaigns with mobile laboratories

AREMA LM and VMM used their mobile laboratories. To have a good temporal representation and several kinds of meteorological conditions, the laboratories were installed during the winter 2002-2003 and during the summer 2003. AREMA LM installed the first mobile station in Halluin and the second one in Wervicq. VMM installed his laboratory in Rollegem-Kortrijk (see figure 3.2).

The mobile stations are equipped to analyse gaseous pollutants (SO₂, NO_x, O₃ and CO) and suspended particles. Additionally particulate matter was collected on filters to analyse heavy metals in the PM2,5 and PM10 fraction and to analyse PAH (winter). During the winter campaign VMM installed also a mobile laboratory equipped with gas chromatography to analyse VOC.

3.1.1 Location

Mobile stations

The sites were located to be near the border and to have a different influence from the Lille agglomeration taking into account the wind. It is necessary that the sites are free of buildings to permit a good circulation of air. The figure below gives the situation of the mobile stations during the measuring campaigns.

- Wervicq-Sud: the mobile station is located Avenue des Sports just near a football place and a sports room. This place is large enough to install the three laboratories for the intercomparison campaign.
- Halluin: During wintertime the mobile station is situated Rue des frères Martel prolognée near the musical school. The road just near has a low traffic. In summer, this site was not available and we installed the unit at stade Wancquet at the periphery of the city. It is closer to the RN17.
- Rollegem: the mobile station is situated at the Tombroekstraat at a small square.

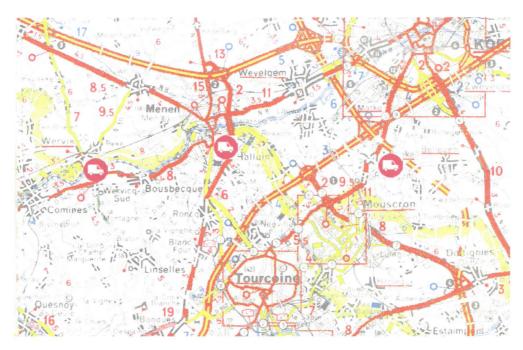


Figure 3.2: Situation of the mobile stations during the measuring campaigns

The three points of study are situated on a line going from Wervicq (west side) to Rollegem (eastside) through the urban pole Halluin-Menen. The distance between the two sites is about 15 km. On each side, the density of population is not important. Wervicq has 4328 inhabitants and a density of 888 inhabitants/km²). At the centre of this zone are situated the towns of Halluin (France) and Menen (Belgium) which have a population of respectively 17628 and 32 154 inhabitants. The density is a little bit higher with respectively 1114 inhabitants/km² and 973 inhabitants/km².

The area is situated at a distance of 8 km from Tourcoing in northern direction. The area between Tourcoing and Halluin can be classified as a suburban zone. The areas around Wervicq and Rollegem are more rural.

The studied zone is crossed by the highway A22-A14, coming from Lille and going to Gent. The highway runs 3 km south-east from Halluin and 3 km north-west from Rollegem. The number of vehicles running on the highway is 27 000 per day with 35% of lorries. Another axis exists (N17) going to Halluin and Menen with 5900 vehicles per day.

There is an important industrial emitter near Wervicq, which emits 1900 ton of SO_2 in 2003. Between Menen and Halluin two important shredders are situated on each side of the border. They work up metallic waste and have no industrial processes. They can be at the origin of diffuse dust emissions. 3 km in north-westerly direction of Rollegem an industrial emitter is situated which emits 341 ton of SO_2 (2002).

Fixed stations

The following fixed stations are situated in the studied area.

Station of Houtem (N029)

The station of Houtem is situated in a rural area at a distance of 500 m from the French border.

Station of Sint-Denijs (Zwevegem) (N050)

The station is located in the Rode Wilgenstraat near the library of Sint-Denijs.

Station of Roeselare (M705)

The station is located near the canal Roeselare-Leie. Different industrial areas are situated in the neighbourhood. High concentrations of PM10 are measured at this location.

Station of Oostrozebeke (OB01)

The station is located in the Hulststraat at Oostrozebeke. Several wood chipboard factories are situated in the neighbourhood of the station. The closest factory is situated 870 m in south-western direction. The other factories are located in eastern direction at a distance of 3000 m. Also at this location high concentrations of PM10 are often measured.

Station of Kortrijk (KO01)

The station is located in the centre of Kortrijk at the school Pleinschool.

Station of Menen (MN01)

The station is located in the Wervikstraat just outside the town of Menen and near the border with France.

Station of Vichte (Anzegem) (E701)

The station E701 is located at the corner of the Otegemsestraat and the A. Rodenbachstraat near a container park. 200 m in eastern direction lies an import road, the N36. The station is situated in a rural and residential area.

Station of Elsegem (Wortegem-Petegem) (E702)

The station is located at a 50 m distance of the rather busy Kortrijkstraat (N453). A small nature reserve is situated in south-eastern direction. The station is situated in a rural area.

Station of Halluin (CAI)

It is situated in the periphery of the city and outdoor of the Lille agglomeration. For this reason, the measurements of nitrogen oxydes are lower than the urban stations but the ozone measurements are higher. First, it was installed to control the emissions of a waste incineration factory. The factory has been renewed a few years ago and the emissions are now less important. Depending on the wind, the station measure important levels of nitrogen oxydes coming from the highway.

Station of Wervicg (DAL)

It is an industrial station which survey an industry situated on the NW. Important values are often measured, but the norms are rarely exceeded.

Station of Tourcoing (TRC)

This is an urban station situated in the centre of Tourcoing which measure mean levels typical of the whole agglomeration. Under bad dispersion conditions, it can measure high levels of NO₂ which overlap the norms. The PM10 concentrations are equivalent to those obtained in others parts of the agglomeration.

Station of Armentières (BEA)

This station is situated in the centre of the town and it is outdoor the Lille agglomeration. The pollution levels are smaller than at the agglomeration.

Station of Lomme (HUG)

It is an urban station from the agglomeration with sometimes important levels of pollutants when the dispersion is bad. The PM levels are higher then the other measurements due to the presence of an emitter in the south.

Station of Roubaix (CHA)

It is an urban station from the north of the agglomeration with sometimes important levels of pollutants when the dispersion is bad. The SO_2 levels are higher than the other measurements due to the presence of a few industries in the town.

Station of Marcq en Baroeul (CTM)

It is an urban station from the agglomeration with sometimes important levels of pollutants when the dispersion is bad. It is situated close to the way RN17.

Station of Lille Faidherbe (FAI)

It is an urban station from the agglomeration situated near the highway A1 at the arrival on Lille. For this reason, the levels of NOx are quite important. It contains both measurements of PM10 and PM2.5.

Station of Lille Five (LAK)

It is an urban station from the agglomeration situated near the ring of Lille. The SO₂ measurements present a few higher concentrations due to the presence of a heating factory.

The measured parameters are given in table 3.1.

Table 3.1: Equipment of the fixed stations (situation: during the campaign)

Town	Code station	SO ₂	PM ₁₀		NO _x	O ₃	
				PM _{2.5}			CO
Houtem	N029	×	Х		Х	Х	
Sint-Denijs (Zwevegem)	N050	×			Х	Х	
Roeselare	M705	×	Х			Х	
Oostrozebeke	OB01	×	Х		Х		
Menen	MN01		x(*2)	x(*2)			
Kortrijk	KO01		x(*1)	x(*1)			
Vichte	E701	×			Х		
Elsegem	E702	×			Х		
Halluin	CAI	×			Х	Х	
Wervicq	DAL	×					
Tourcoing	TRC	×	Х		Х	Х	
Roubaix	CHA	×			Х	Х	
Marcq en Baroeul	СТМ	×	Х		Х	Х	
Lomme	HUG	×	Х	х	Х	Х	
Lille Faidherbe	FAI	x(*3)	Х	Х	x(*3)		
Lille Five	LAK	x(*3)	Х		x(*3)		
Armentières	BEA	x(*3)			x(*3)	Х	

^(*1) from 20th March 2003 on

^(*2) from 6th February 2003 on

^(*3) data not used for comparison with mobile stations

3.1.2 Meteorological conditions

During the winter campaign the wind roses looked like those obtained for a whole year. Most of the winds came from the south-west and the second most important direction was north-east. In summer, we had a more important part of wind coming from north-west. In December there were a few sunny days on 18th and 19th and then from 6th to 12th January. The temperatures were low and the hourly minimum reached -7,5°C. The rest of the campaign was cloudy with mild temperatures around 12°C. The pressure had important variations between 995 and 1035 hPa, which indicates the presence of a depression and an anticyclone. In summer, there were fewer fluctuations of the meteorological parameters. The mean temperature was quite constant and the daily maximum varied from 19°C on 2nd and 3rd July to 32°C on 15th July. The maximum temperature exceeded 25°C on June 22nd, 26th and 29th. In July we had a warm period from 8th to 15th with temperatures superior to 25°C. Between these two periods we had only one short period with low pressure and cloudy sky in the beginning of July.

3.1.3 SO₂

The SO₂ measurements during the winter and summer campaign are low. During wintertime the highest concentrations are measured from 18th to 22nd December and from 8th to 13th January. These days correspond to an accumulation of the pollutants under bad dispersion conditions. The wind mostly comes from the east with a low speed. During summer time the concentrations are often elevated in the mobile and fixed stations at Wervicq. The mobile laboratory of Rollegem and the fixed station of Sint-Denijs are influenced in north-eastern direction by the power-station of Ruien, situated in the Flemish municipality of Kluisbergen. At the station of Elsegem we also see the influence of the power station from the south-western direction. The wind is coming only rarely from the power station Ruien for the station of Vichte. At the station of Oostrozebeke, high concentrations are measured from the south-west direction where a wood chipboard factory is situated. Especially at the fixed stations of Tourcoing, Roubaix and Marcq and Lomme we see elevated SO2 concentrations coming from the north-east. The source is the local heating whose emissions accumulate when the dispersion is less important. During summer time we also see the influence of the chipboard factory at the station of Oostrozebeke. The mobile laboratory at Wervicq and the fixed station of Wervicq are measuring the influence of an industrial source situated west of the fixed station and using some products containing sulphur.

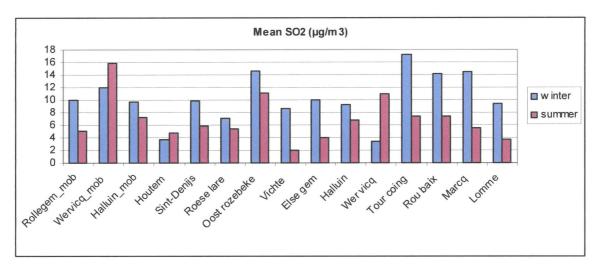
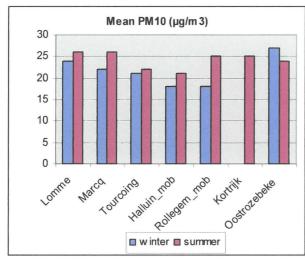


Figure 3.3: Comparison of the mean values of SO₂

The hourly value of 350 μ g/m³ and the daily value of 125 μ g/m³ of the future limit values for the protection of health (1999/30/EC) for SO₂ are not exceeded during the measurement campaigns.

3.1.4 PM10

During the winter campaign there were also 2 periods with high PM10 concentrations namely 20th to 21st December and 10th to 12th January. During the summer campaign a period of higher concentrations started at 15th July, the last day of the campaign. The average PM10 concentrations are higher during the summer campaign except for Oostrozebeke. During the winter campaign the measurements are generally higher when to wind is coming from the north-east compared to the south-west. At Oostrozebeke the highest concentrations are measured in the south-western direction where a wood chipboard factory is situated. During the summer campaign the measurements are more homogeneous over the different wind directions. At Oostrozebeke we see again higher concentrations when the wind is coming from the south-west. At Roeselare the concentrations are elevated when the wind is coming from the east. In eastern direction an industrial area is situated.



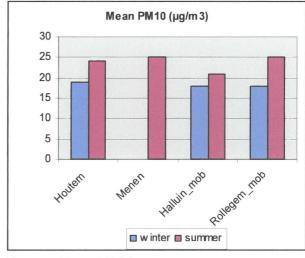


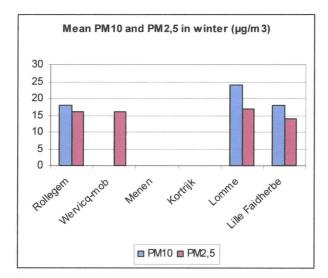
Figure 3.4: Mean values of PM10 from south to north (left) and from west to east (right)

The limit value of 40 μ g/m³ for the protection of health for PM10 (1999/30/EC) is not exceeded during the measurement campaign in winter and summer. After correction with the factors used in Flanders this limit value is exceeded in the station of Roeselare during the summer campaign. The daily value of 50 μ g/m³ for the protection of health (1999/30/EC) is exceeded during winter and summer.

3.1.5 PM2.5

As for PM10 during the winter campaign there were 2 periods of high PM2,5 concentration and a period of higher concentrations started during the summer campaign at 15th July, the last day of the campaign. Comparable to PM10 the PM2,5 measurements during the winter campaign are generally higher when the wind is coming from the north-east compared to the south-west. During the summer campaign the measurements are also more homogeneous over the different wind directions.

In the studied area in France and in Flanders there are only a few locations where PM10 and PM2,5 are measured together. In the winter the difference between PM10 and PM2,5 is smaller than in the summer.



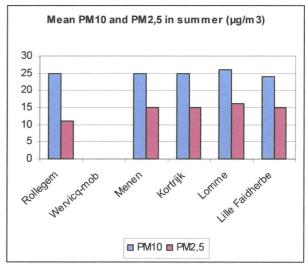
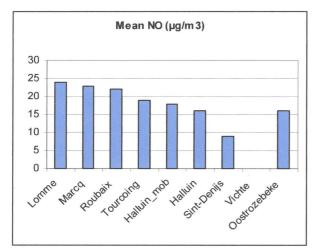


Figure 3.5: Comparison of PM10 and PM2.5 during the winter and summer campaigns

3.1.6 NOx

Two periods with higher concentrations can also be distinguished for NO and NO_2 namely from 18th to 21st December and from 8th to 12th January. In the winter period the lowest mean values for NO are obtained in Flanders: Elsegem, Houtem and Sint-Denijs. The NO value measured at Oostrozebeke is the only one close to the values obtained in the agglomeration of Lille which vary from 16 to 24 μ g/m³. In summer there are less differences: the mean values for NO vary from 1 to 5 μ g/m³. The dispersion in summer is more efficient and there is more ozone to consume NO. The levels of NO_2 are higher in January than in December. In summer, the levels are more regular. Most part of the daily maximum hourly values are between 40 and 60 μ g/m³ for urban stations and between 20 and 40 μ g/m³ for rural stations. The presence of the NO an NO_2 maximum during the morning and in the afternoon are characteristics for the peak of traffic that exists in and around important agglomerations. This is the reason why the higher profiles are those of the urban. In the direction of the dominant wind,

the concentration of NO decreases with the distance from Lomme and the ambient concentration is divided by 2,5 (-60%) after 25 km in Sint-Denijs. This decrease is stopped near Oostrozebeke where the ambient concentrations of NO have a comparable level as in Halluin. In the west-east direction, we observe an increase of the concentrations approaching the agglomeration plume (near Halluin) and afterwards the concentrations trend towards their basic level in Elsegem. The levels in the rural part are 70% lower than in the urban part.



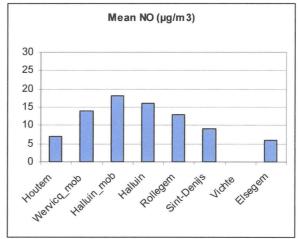
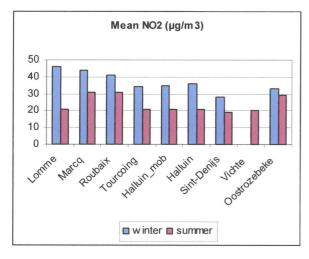


Figure 3.6: Mean values of NO from south to north (left) and from west to east (right) in winter

On a parallel axis to the dominant wind, a decrease for NO_2 is observed in winter with levels going from 46 to 28 μ g/m³, what represents a decreasing of 40%. In summer, the profile is not the same. All the stations show mean concentrations close to one another (about 20 μ g/m³) except Marcq, Roubaix and Oostrozebeke, which present values of 30 μ g/m³. We can suppose that the better dispersion trends to equalise the levels over the whole region. On the west-east axis, the winter levels of NO_2 look like those for NO with the highest values (35 μ g/m³) in the centre and the lowest (20 μ g/m³) on each side.



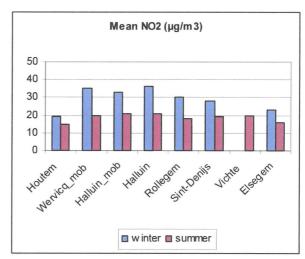


Figure 3.7: Mean values of NO₂ from south to north (left) and from west to east (right) in winter and summer

The hourly value of 200 μ g/m³ of the future limit value for NO₂ for the protection of health (1999/30/EC) is not exceeded during the measurement campaign. The annual limit value for the

protection of health (40 μ g/m³) is exceeded during the winter campaign in the urban stations of Roubaix, Marcq and Lomme.

3.1.7 O₃

The plots of the hourly values for O_3 in winter and summer show a good agreement between the curves of the different stations. We observe very well the daily rhythm of appearance and disappearance of ozone. In winter, there are a few days without ozone (20th and 21st December) what corresponds to high levels of nitrogen oxides. At these moments high atmospheric pressure and low winds prevail which limit the dispersion of pollutants. At the opposite, the levels of ozone can be as high as 80 μ g/m³ during days with important wind speed. Ozone levels can be higher in rural areas than urban areas. In summer, the maximum levels reach 215 μ g/m³ in Armentières and 213 μ g/m³ in Roubaix on 15th July. In Flanders, we obtained 210 μ g/m³ in Houtem and 209 μ g/m³ in Sint-Denijs on the same day. This day the highest levels are obtained over the Euro-region. Most of the stations exceeded the hourly threshold (180 μ g/m³) on 15th July.

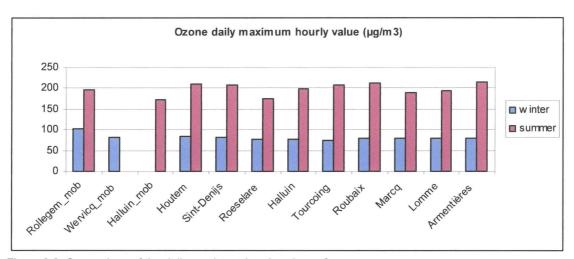


Figure 3.8: Comparison of the daily maximum hourly values of ozone (The value from Wervicq_mob for the summer campaign is not indicated on the plot because the mobile station has gone away on 15th July)

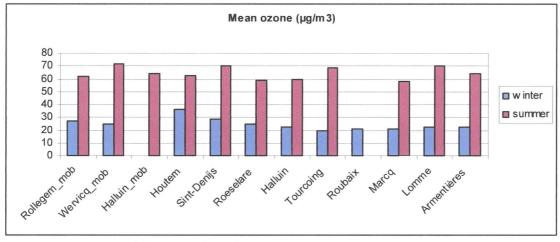


Figure 3.9: Comparison of the mean values of ozone

3.1.8 CO

For CO we distinguish again 2 periods with higher concentration: 20th December to 21st December and 10th January to 12th January. During the winter the CO concentration increases from 6:00 UT due to the building heating and the morning traffic. In the late afternoon the concentration increases again due to the evening traffic. In the nighttime the CO concentration stays high. In the summer the CO concentration is low. Only in the morning we see a slight increase due to the traffic. After the traffic peak in the morning the concentration decreases and stays low during the rest of the day.

The future limit value for the protection of health for CO of 10 mg/m³ as a maximum daily 8-hour mean (1999/30/EC) is not exceeded during the measurement campaign.

3.1.9 Heavy metals

The mean values for lead in PM10 for the different measurement campaigns were lower than the limit value (500 ng/m³ as a yearly average). The mean values for arsenic, cadmium and nickel in PM10 for the different measurement campaigns are also lower than the respective target values (6 ng/m³ for Arsenic, 5 ng/m³ for Cadmium and 20 ng/m³ for Nickel as a yearly average).

3.1.10 VOC

The concentrations for VOC in Rollegem are comparable with the rest of Flanders. Higher concentrations are recorded when the wind comes form east to south-east. This is probably due to a local source.

The limit value for benzene for the yearly average in ambient air is determined at 5 µg/m³. This value was not exceeded during the measurement campaign.

3.1.11 PAH

The PAH concentrations measured are part of the EPA-priority list for PAH. Benzo(a)pyrene is selected as indicator. On European level a target value of 1 ng/m³ as yearly mean for benzo(a)pyrene is under discussion. The average concentration for benzo(a)pyrene measured here is 0,31 ng/m³ thus finding itself beneath the proposed limit value. A local source having a perceptible influence cannot be determined.

3.2. Measurements at Menen and Kortrijk

In Menen and Kortrijk, VMM started supplementary measurements of PM2,5 and PM10. In Menen supplementary measurements of heavy metals in PM10 were also started. PM2,5 was sampled on filters for the analysis of heavy metals (VMM and UA) and for the analysis of anions and cations (UA). UA, using passive samplers, determined at this location a certain number of gaseous pollutants and analysed a certain number of filters on PAH's. In Kortrijk, VMM started supplementary measurements of PM2,5 and PM10.

3.2.1 PM at Menen and Kortrijk

During the measurement campaigns in winter and summer PM10 and PM2,5 were determined both by gravimetric method (Leckel) and automatic method (TEOM) in Rollegem (winter and summer campaigns) and Menen (summer campaign). The regression equations indicate that in Rollegem for PM10 in summer a better agreement between the gravimetric method and the automatic method occurs then in the winter. For PM2,5 the opposite is true. In winter the agreement between the gravimetric method and the automatic method is better for PM2,5 than for PM10, in summer the agreement is better for PM10 than for PM2,5.

PM2,5 measurements at Menen and Kortrijk are rather similar. The PM10 measurements are higher at Menen then at Kortrijk. Using the correction factor 1,47, the limit value for the yearly average of 40 µg/m³ for the protection of health (1999/30/EC) is exceeded in 2003 at Menen (42 µg/m³), but not at Kortrijk (38 µg/m³). The daily value of 50 µg/m³ for the protection of health (1999/30/EC) is exceeded in 2003 more then the permitted 35 exceedances both at Menen (79 exceedances) and Kortrijk (53 exceedances). For 2003, the limit value for the daily values is exceeded in all the other PM10-stations in Flanders. The limit value for the yearly average is exceeded in 8 of the 19 PM10-stations. In the first six months of 2004 the limit value for the yearly average of 40 µg/m³ is not exceeded at Menen and Kortrijk and the daily value of 50 µg/m³ is exceeded 21 times at Menen and 19 times at Kortrijk.

The pollution roses for PM10 and PM2,5 at Kortrijk are rather homogeneous. At Menen we see higher concentrations coming from the north to the east to the south. This is also true to a less extent for PM2.5.

The fraction PM2,5 in PM10 is 59 % at Menen and 61 % at Kortrijk.

3.2.2 Heavy metals at Menen

Heavy metals in PM2.5

Zinc, lead and copper are the most abundant heavy metals in PM2,5, during all seasons. Vanadium, chromium, manganese, arsenic and nickel are present in each sample, although in smaller concentrations. Cadmium and antimony are only represented by very small amounts. The average concentrations of vanadium, chromium, nickel, copper and arsenic all show the highest concentration during winter. Lead, zinc and manganese are characterised by a similar seasonal variability: all three heavy metals show higher concentrations during autumn and winter, more average concentrations during spring, and lowest concentrations in summer. The concentrations of lead, zinc and manganese also show the largest difference between the highest and the lowest detected concentration, each season.

Heavy metals in PM10

Zinc and lead are the most abundant heavy metals in PM10, followed by manganese and copper. Chromium, nickel, antimony and arsenic are present in each sample, although in smaller concentrations. Cadmium is only represented by very small amounts. Depending on the heavy metal the highest concentration is measured in the winter (lead, nickel, arsenic, manganese and cadmium) or in autumn (zinc, copper, antimony and chromium). All heavy metals show the lowest concentrations in the summer. Chromium, nickel, antimony, arsenic and cadmium show less seasonal variability then manganese and copper. Lead and zinc show the largest variability between the seasons. The concentrations lead, zinc, copper and manganese show the largest difference between the maximum and the minimum detected concentration, each season.

3.2.3 Anions and cations at Menen

During all seasons, most abundant ions in the PM2.5 fraction are nitrate, sulphate and ammonium. Fluoride, chloride, potassium, magnesium and calcium show less contribution to the total water-soluble ion content, with average concentrations smaller than 1 µg/m³. The mean nitrate concentration is most elevated during spring and summer campaigns. Both sulphate and ammonium concentrations were lowest during summer campaigns.

3.2.4 Elemental composition and water-soluble ion concentrations in PM2.5 at Menen - Backward trajectories

It can be concluded that the PM2.5 fraction, detected in Menen is highly dependable upon the backward trajectories of the air masses. The least heavy metal contaminated air in Menen is registered in case the air originated from the Atlantic Ocean. Most often, heavy metal polluted air was detected when the air masses passed Germany or the southeastern part of United Kingdom before reaching Menen. In the case of air masses passing Germany, elevated concentrations of the heavy metals chromium, manganese, copper, zinc, lead and vanadium were detected. Air masses passing the southeastern part of United Kingdom, mainly London and its surroundings, were characterised by elevated concentrations of the heavy metals vanadium, chromium, manganese, zinc, lead, and sulphates.

3.2.5 Gaseous pollutants at Menen

The gaseous compounds NO_2 , SO_2 , NH_3 and BTEX have been measured in Menen by means of radiello diffusion tubes. The annual mean NO_2 concentration of 25 μ g/m³ did not exceed the annual limit value for the protection of health of 40 μ g/m³. Only a small seasonal variation between the data was registered. During winter, the highest NO_2 levels were detected; maximum daily values of 49.4 μ g/m³ were reached.

Concerning SO₂, a very low annual mean level of 3.0 µg/m³ was detected.

Yearly average concentrations of 29.6 $\mu g/m^3$ are detected for ammonia. During the periods 18th March until 1st April and 5th August until 18th august, elevated ammonia concentrations were detected. Maximum weekly concentrations of 75.8 $\mu g/m^3$ were registered.

Proportional concentrations of the different BTEX compounds are registered during each sampling period. The limit value for benzene for the protection of human health (5 μ g/m³) was not exceeded in Menen.

3.2.6 PAH at Menen

Filter samples collected during this Inter Region project were analysed for 16 US EPA criteria PAH. The concentration of lighter PAH were found relatively very low and were dominated by naphthalene and phenanthrene, whereas heavier PAH fluoranthene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene, benzo(ghi)perylene and indeno(123cd)pyrene dominates the total PAH concentration in particulate matter. Further the concentration of benzo(a)pyrene found to be lower than its proposed target value (1 ng/m³).

Seasonal and meteorological parameters also influence the PAH concentration. Generally higher concentrations in the winter season were found. Further the reported daily PAH concentrations were relatively high when the prevailing wind direction was southwest in Menen at the sampling site.

The application of correlation coefficient calculation and PCA was applied to find the possible source of PAH which indicate towards vehicular emission as a major source although other sources like wood burning/ coke production etc. might also exist.

3.3 Dioxins and PCB126

Since 1995 VMM measures the deposition of dioxin in Flanders. Since 2002 the deposition of the dioxin-like PCB126 was measured simultaneously. In order to determine the influence of the northern part of France, VMM took measurements on different locations nearby the French border. Samples were collected in Moeskroen, Veurne, Wervik, Kortrijk and Menen. Menen houses 5 measurement stations. However, high depositions measured in one particular station incited to put in use a sixth station. Two stations in Menen started with measurements on a monthly basis. Complementary samples were collected on the grounds of a local shredder company and in Halluin.

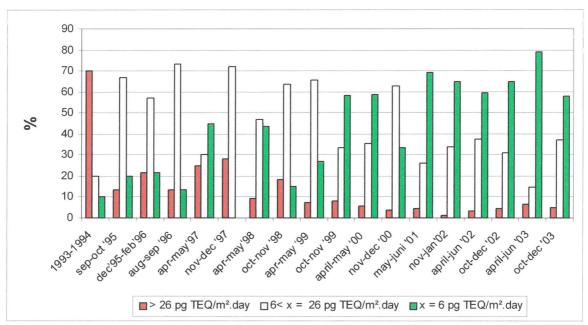


Figure 3.10: Exceedance of guide values expressed as a percentage of the monthly values of allowed dioxin depositions (The bars represent the percentage of samples, which comply the guide values)

The high levels of dioxin deposition repeatedly measured in the area of Menen are in contrast with the decreasing trend of dioxin deposition in Flanders. Moreover, the high levels of PCB126 deposition measured in Menen are not in accordance with the average PCB126 deposition of 2 pg TEQ/m².d measured in Flanders. The pollution is concentrated in a small area around the river Leie and is not extended to the rest of Menen. The highest dioxin and PCB126 levels were found in samples taken close to the Flemish shredder plant, situated near the Leie on the border between France and Belgium. Since bulk materials are unloaded near this sampling point, it is not clear whether the clouds of blowing dust or emissions from the shredder installation provokes the high deposition.

The case of Menen led to investigations in other areas around shredder plants. Similar high depositions of dioxin and PCB126 were found in areas around other shredder plants. It appears that this kind of industry is a source for dioxins and PCB126 emissions.

3.4 Benzene and NO₂ in West-Vlaanderen

A study was done in West-Vlaanderen by VMM and UA to map out in a detailed way the concentration levels of BTEX (benzene, toluene, ethylbenzene and the tree xylene isomers) and NO₂.

3.4.1 Measurements of benzene in West-Vlaanderen

There were no exceedances of the limit value for benzene (yearly average of 5 µg/m³) measured. The highest concentrations for benzene are measured at traffic arteries and urban background stations. But also household heating is, next to traffic, a major source for benzene. In general, the benzene values in the winter are higher then in the summer, but the winter/summer ratio varies from location to location. The higher values in the winter can be explained by more pollution due to heating of households in the winter. In rural areas the traffic (constant source) has a relatively smaller influence, so the winter-summer ratio changes the most.

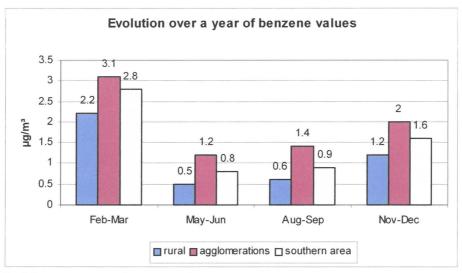


Figure 3.11: Evolution over a year of benzene values

3.4.2 Measurements of NO₂ in West-Vlaanderen

In the rural areas there's not one measuring point with an exceedance of the EU yearly average limit value for NO_2 . Also in agglomerations the yearly averages were below the limit value of $40~\mu g/m^3$, but in Brugge and Roeselare the yearly averages were approximating the limit value. At some traffic arteries in the agglomerations and at some urban background locations, there were exceedances in some seasons (mainly spring and summer) up to $74~\mu g/m^3$. The highest concentrations are measured in agglomerations. At some traffic locations in the agglomerations and the southern area higher values in the spring and summer were measured. At locations were lot of NO is emitted through the traffic, the increase in the summer is due to the conversion of NO with ozone to NO_2 (conversion is related to sun intensity). In the rural areas, there is less traffic, what results in not much extra production of NO_2 in the summer due to conversion with O_3 , so (almost) no annual variation.

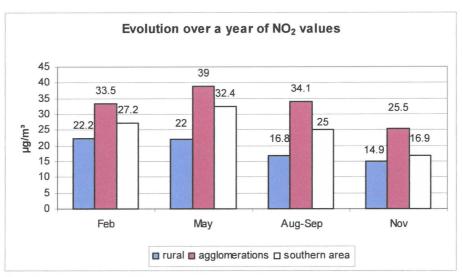


Figure 3.12: Evolution over a year of NO₂ values

For more information/ results: see complete Technical report, action 2: 'Measurement campaigns in the Euroregion, 2002-2004'

4. Action 3: Communication

4-1. Scientific development monitoring and transfer of knowledge

4-1.1 Documentation database

A documentation database devoted to atmospheric particles and health impact was constituted. This database is available on the project website.

A special issue of the APPA review "Air Pur" was devoted to Atmospheric particles, and EXPER/PF project (Air Pur n°66, 2004)

4-1.2 EXPER/PF database descriptive documents

A database short descriptive document (14 pages, French and Flemish versions) has been realised for end users. The first version was carried out by HYGEOS and APPA, and the document was completed by VMM and AREMA LM, and translated by VLIZ.

This document was distributed during the 2003, November 28th seminar, and is now available online on the project website. During year 2004, the document (French and Dutch versions) was downloaded by about 100 persons.

A 4 page presentation brochure is used by the partners to promote the database: 2000 specimens have been printed in October 2004, and a pdf version can be downloaded on the project website.



Figure 4.1 EXPER/PF brochure

4-2. Project Promotion

4-2.1 Logo

A logo was carried out by APPA, and received the downstream of project partners. This logo is now used for all communication supports (paper documents, website, ...), with logos of the European Community and of the Interreg III France-Walloon-Flanders program.



Figure 4.2 EXPER/PF project logo

4-2.2 Articles and communications

Scientific articles in reviews with referees:

TORFS R., ROEKENS E., MATHEEUSSEN C., DUMOLLIN J. (2002). Verspreiding van zwevend stof. Chapter 2.5 in MIRA-T 2002, p. 157-162.

BORDE R., RAMON D., SCHMECHTIG C., SANTER R.. (2003). Extension of the DDV concept to retrieve aerosol properties over land from the Modular Optoelectronic Scanner sensor. International Journal of Remote Sensing, vol 24, No 7, 1439-1467.

SCHMECHTIG C., CARRERE V., DUBUISSON P., ROGER J.-C. and SANTER R. (2003). Sensitivity analysis for the aerosol retrieval over land for MERIS. International Journal of Remote Sensing, Vol 24, No14, 2921-2944.

TORFS R., MATHEEUSSEN C., DUMOLLIN J., ROEKENS E., BOSSUYT M. (2003). Verspreiding van zwevend stof. Chapter 2.5 in MIRA-T 2003, p. 183-190.

EYCKMANS K., DE HOOG J., VAN DER AUWERA L. AND VAN GRIEKEN R. (2003) Speciation of aerosols by combining bulk ion chromatography and thin-window electron probe microanalysis, Journal of Environmental Analytical Chemistry, vol. 83, 777-786

DEUTSCH F., STRANGER M., KAPLINSKII A.E., SAMEK L., JOOS P. AND VAN GRIEKEN R. (2003) The impact of precipitation amount on the concentration of elements and ions in urban aerosol particles, Atmospheric and Oceanic Optics, vol. <u>16</u>, 850-855

DEUTSCH F., STRANGER M., KAPLINSKII A.E., SAMEK L., JOOS P. AND VAN GRIEKEN R., (2004) Elemental and ionic concentrations in the urban aerosol in Antwerp, Belgium, Journal of Environmental Science and Health, Part A: Toxic/Hazardous Substances & Environmental Engineering, vol. 39, 539-558

TORFS R., SCHROOTEN L., MATHEEUSSEN C., VERLINDEN L., ROEKENS E., BOSSUYT M. (2004). Verspreiding van zwevend stof. Chapter 2.5 in MIRA-T 2004.

VALLIUS M., JANSSEN N.A.H., HEINRICH J., HOEK G., RUUSKANEN J., CYRYS J., VAN GRIEKEN R., DE HARTOG J.J., KREYLING W.G. AND PEKKANEN J. (2005), Sources and elemental composition of ambient PM2.5 in three European cities, The Science of the Total Environment, vol. 337, 147-162

RAVINDRA K., BENCS L., WAUTERS E., DE HOOG J., DEUTSCH F., ROEKENS E., BLEUX N., BERGHMANS P. AND VAN GRIEKEN R. Seasonal and site specific variation in PAH concentrations in Flanders, Belgium, and their relation to anthropogenic activities, J. Environ. Monitoring, submitted

Acts of conferences:

RAMON D. SANTER R., AND VIDOT J. (2003). First validation of MERIS aerosol product over land. European Space Agency. *A paraître dans l'ESA Bulletin*.

SANTER R., VIDOT J., RAMON D. (2003). Meris Level 2 Products Over Land Validation and Potential improvements, IGARS, Toulouse, Juillet 2003, *A paraitre dans IEEE transactions*.

ROEKENS E. (2003). A preliminary apportionment of the sources of ambiant PM2.5 in Flanders, Belgium. European Aerosol Conference 2003, 31 August-5 September, Madrid, Spain.

BOKOYE A. I., SANTER R., VIDOT J., MARTINY N., MERIAUX, X., (2003). Evaluation of Junge power law as tool for atmospheric correction validation. SPIE International Symposium, Remote sensing, 8-12 September, Barcelona, Spain. 5235-17

VIDOT J., SANTER R. (2003). SeaWiFS level 3 product over land. SPIE International Symposium, Remote sensing, 8-12 September, Barcelona, Spain. 5235-48

VIDOT J., SANTER R., RAMON D. (2003). Remote sensing of particle matter using SeaWiFS. SPIE International Symposium, Remote sensing, 8-12 September, Barcelona, Spain. 5235-82

RAVINDRA K., GODOI A.F.L. AND VAN GRIEKEN R. (2003) Low-pressure GC-ITMS method for the fast determination of polycyclic aromatic hydrocarbons (PAHs) in environmental samples Abstracts of the 26th International Symposium on Capillary Chromatography and Electrophoresis, nr. 74, published on web under: http://www.elsubmit.com/esubmit/cce2003/show/.global/Search

BERGHMANS P., BLEUX N., ROEKENS E., DE HOOG J., BENCS L. AND VAN GRIEKEN R. (2003), A preliminary apportionment of the sources of ambient PM2.5 in Flanders, Belgium, Abstracts of the European Aerosol Conference, Journal of Aerosol Science, pg. S425-S426

RAVINDRA K., GODOI A.F.L., VAN VAECK L. AND VAN GRIEKEN R. (2004) Fast chromatographic determination of polycyclic aromatic hydrocarbons (PAHs) Abstracts of ERCA2004 – European Research Course on Atmospheres, 1 pg.

Communications in scientific colloquia

DESMEDT M., ROEKENS E., DE FRE R., SWAANS W., VANERMEN G. (VMM): "Methodological survey of the dioxin deposition measurement with Bergerhoff gauges", 22nd International Symposium Dioxiin 2002, Barcelona, 11-16 September 2002

ROEKENS E. (VMM): Uiteenzetting omtrent de dioxineproblematiek in Menen, Menen, 25 November 2002.

JOOS P. (UA). Sub-minute determination of BTEX in environmental samples using low pressure GC-ITMS, 25th International Symposium on Capillary Chromatography, Riva del Garda, Italy, 13-17 May 2002

ROEKENS E. (VMM): "Opbouw van het telemetrisch meetnet in België, huidige concentraties aan luchtverontreinigende stoffen in Vlaanderen, luchtkwaliteit in Vlaanderen", Cursus medische milieukunde, Brussel, 19 March 2003.

ROEKENS E. (VMM): "Air Pollution Abatement Planning in Belgium", Workshop Air Pollution Abatement Plans, Berlin, 2-3 April 2003

MATHEEUSSEN C., ADRIAENSSENS E., WAUTERS E. (VMM): "PM10 intercomparison measurements of continuous instruments with the reference method", Colloquium QA/QC in the field of emission and air quality measurements, Praha (CZ), May 21-23nd2003

RAMON D., SANTER R., VIDOT J.: "Determination of fine particulate matter from MERIS and SeaWiFS aerosol data", Colloquium "MERIS users Workshop", ESA-ESRIN (Agence spatiale européenne), Frascati, Italy, 10-13 November 2003.

RAVINDRA K., GODOI A.F.L. AND VAN GRIEKEN R. (2003) Low-pressure GC-ITMS method for the fast determination of polycyclic aromatic hydrocarbons (PAHs) in environmental samples, 26th International Symposium on Capillary Chromatography and Electrophoresis, Las Vegas, USA, 18-22 May 2003

BERGHMANS P., BLEUX N., ROEKENS E., DE HOOG J., BENCS L. AND VAN GRIEKEN R. A preliminary apportionment of the sources of ambient PM2.5 in Flanders, Belgium EAC 2003 – European Aerosol Conference, Madrid, Spain, 31 August – 5 September 2003

ROEKENS E., VAN DEN HENDE M.-R., DUMOLLIN J., DUMONT G.: 'De luchtverontreiniging in Vlaanderen', Beleidssymposium, aanpak en instrumenten voor de bestrijding van de grensoverschrijdende luchtverontreiniging, AMINAL, Brussel, 5 March 2004.

RAMON D., BLANCHET A., SCHADKOWSKI C., DILLIGEARD E., SANTER R. and VIDOT J.: Integrated Air Quality Monitoring Service Using Ground Networks Measurements and EO Products. *Proceedings of the ESA Workshop on ENVISAT*, Salzburg (Austria) 5-9 September 2004.

SCHADKOWSKI C., BLANCHET A., RAMON D., DILLIGEARD E.: Constitution and promotion of an euroregional database on atmospheric particulate matter. *Proceedings of the 13th World Clean Air and EnvironmentalProtection Congress and Exhibition*, London, 23-27 August 2004

DEUTSCH F., LEFEBRE F., VANKERKAM J., ADRIAENSEN S., MENSINK C., BLOMMAERT F., ROEKENS E.: Implementation of the gas phase mechanism CACM and the fine particulate matter module MADRID2 into the EUROS model, GLOREAM Workshop, Copenhagen, 6-8 September 2004

ROEKENS E.: PM measurements in Belgium, Euroregion – EXPER/PF project, WHO Workshop 'Review of methods for monitoring PM10 and PM2.5', Berlin, 10-12 October 2004.

BERGHMANS P., BLEUX N., ROEKENS E., MATHEEUSSEN C., VERLINDEN L.: Assessment of PM10 source contributions as a "hot spot" region", Monitoring Ambient Air, Implications of New Directives and Standards, London, 15-16 December 2004 (E. Roekens was chairman of the session 'The PM Debate)

VAN GRIEKEN R. X-ray spectrometry for environmental applications. Abstracts of the 2004 Buenos Aires X-Ray Spectrometry Workshop, pg. 85-86

COCHEO C., STRANGER M., SACCO P., PAGANI D., QUAGLIO F., GODOI A.F.L., GODOI R., POTGIETER-VERMAAK S., VAN GRIEKEN R. Validation of the diffusive sampler radiello for the measurement of formic and acetic acids in museum environments, 6th Indoor Air Quality Meeting, Padova, Italy, 10-12 November 2004

Articles in partner's reviews

- 2003, February: "Bulletin de l'Air" (OPAL'Air review) n° 110
- 2003, March: "Air Pur Infos" (APPA review) n° 7
- 2003, April-May: "Vlizine" (VLIZ review) n° 4-5
- 2003, May: "Verrekijker" (VMM review)
- 2003, June : "Bulletin de l'Air" (OPAL'Air review) n° 114
- 2003, October-November: "Vlizine" (VLIZ review) n° 10-11
- 2003, Décember: "C'est dans l'Air" (AREMA LM review) n°85
- 2004, March: "C'est dans l'Air" (AREMA LM review) n°86
- 2004, July:"Air Pur" (APPA scientific review) n°66

Articles in other reviews

- 2002, February: "Hoe gezond is ademen, de Vlaamse lucht wordt nauwkeurig in het oog gehouden" (Roekens E., Matheeussen C.), in Ecotips 02/2, p. 25-29
- 2002, December: "Meten en analyseren van de omgevingslucht" (Roekens E.), in Milieutechnologie, nr. 11
- 2003, March: "Pollution Atmosphérique" n°177, in "Lu sur le web" pages
- 2004, April: "Regards Transfrontaliers" n°6

Technical meetings, lobbying

- 2002, March, Belgian expert in the working group CEN/TC264/WG14, Reference method for the determination of Pb/Cd/Ni/As in PM10 dust and participation at the field validation programme since 1998., 14th meeting, Berlin (VMM)
- 2002, July 1st to 2nd: Bioaerosols, A view from different perspectives, Karlsruhe (*VMM*)
- 2003, February 8th: Technical meeting of the "Maison Régionale de Promotion de la Santé",
 Lille (APPA)
- 2003, February 11th to 12th: Monitoring Ambient Air, European Perspective on Particulate and Photo-oxidants, London (*VMM*)
- 2003, February 20th to 21st: Luchtkwaliteit in en rondom steden, Apeldoorn (*VMM*)
- 2003, March 11th to 12th: Air Quality in the Slovak Republic Monitoring of Air Pollution and Audit of Quality System, Slovakia (*VMM*)
- 2003, April 2nd: APPA annual seminar
- 2003, April 2nd to 4th Salon ENVIRONORD, Lille (HYGEOS)
- 2003, April, Belgian expert in the working group CEN/TC264/WG14, Reference method for the determination of Pb/Cd/Ni/As in PM10 dust and participation at the field validation programme since 1998., 17th meeting, Vienna (VMM)
- 2003, May 15th & 21st: Journalists continuous training (APPA)
- 2003, May 27th : « Particles & Health » APPA Commission meeting, Kremlin-Bicêtre (ADRINORD)
- 2003, June 13th: Presentation to working group "Health impact" of the PRQA (Regional Plan for Air Quality), Lille (AREMA LM)
- 2003, October 2nd: Technical meeting with ADEME (French Environment & Energy Agency)
 and Nord-Pas de Calais Regional Council (Environment Department), Lille (APPA, ADRINORD, HYGEOS, OPAL'AIR)
- 2003, October 20th 21st, CAFÉ workshop on Second Particulate Matter, Stockholm (*VMM*)
- 2003, October, Belgian expert in the working group CEN/TC264/WG14, Reference method for the determination of Pb/Cd/Ni/As in PM10 dust and participation at the field validation programme since 1998., 18th meeting, Ispra (VMM)
- 2003, November 17th: ESA Chemical Weather Project, Rome (*VMM*)
- 2003, November 28th : « Air Pollution and euroregional database Flanders -Nord-Pas de Calais » Seminar, Lille (*All partners*) details in § 4-2.3a

- 2003, December 9th : « Particles & Health » APPA Commission meeting, Kremlin-Bicêtre (APPA)
- 2003, December 9th-11th: Monitoring Exposure to Air Pollution, London (VMM)
- 2004, February 17th: "Modélisation de la qualité de l'air / Air quality modeling" Seminar, Lille (HYGEOS)
- 2004, March 10th-11th: Journées techniques nationals Dioxines et Polluants Organiques Persistants, Paris (*VMM*)
- 2004, June 21st: ATTMA Technical meeting (HYGEOS)
- 2004, October 18th: Technical meeting with the Nord-Pas de Calais Regional Health Authorities (DRASS-CIRE) (*HYGEOS*)
- 2004, October 20th: Chemical and biological characterisation of ambient air coarse, fine and ultrafine particles for human health risk assessment in Europe, PAMCHAR workshop, Praha (*VMM*)
- 2004, October, Belgian expert in the working group CEN/TC264/WG14, Reference method for the determination of Pb/Cd/Ni/As in PM10 dust and participation at the field validation programme since 1998., 20th meeting, London (*VMM*)
- 2004, November 30th: "Lucht en Fijn Stof Infonamiddag omtrent emissies, luchtkwaliteit en fijn stof problematiek", Seminar, Aalst (*All partners but especially the flemish ones*) details in § 4-2.3b
- 2005: European Aerosol Conference 2005 R. Van Grieken and E. Roekens are members of the organizing committee

4-2.3a Seminar for EXPER/PF database final users, 2003 November 28th

The seminar "Air Pollution and Euroregional database: Flanders-Nord Pas de Calais" was held in Lille on November 28th. The detailed program and registration list are given in appendix 4.1 and 4.2. All participants received the documents issues (abstracts and slides of the speakers) in French, Flemish and English for some of them. The abstracts can be downloaded on the EXPER/PF website.

4-2.3b Final seminar for larger public, 2004, November 30th

In this growing multimedia era the setting up of a multilingual website and database were two of the most important pillars of the communication in this project. Although the multimedia era also stands for a more prevalent usage of English for the distribution of information, it was clearly experienced while carrying out the project that people and more specific the large public is looking for information in its own mother tongue. Therefore it was most important to have all information distributed, up to now, in both French and Dutch. A better understanding and thus a better knowledge of the exposure of people to small particles is, apart from the scientific world, a matter of distribution of information in a comprehensive way.

It was experienced that even a more restraint public of civil servants, journalists and people from the medical sector were more attracted to information in their mother tongue which obliged the participants to the project to split up the communication at the end of the project in two parts in order to be able to spread the information as largely as possible, in Dutch and in French separately. In Flanders the project partners organised its conference in the VMM building in Aalst. In order to inform a large public (a thousand invitations were send out – invitation and registration list can be found in annexes 4.3 and 4.4), the problem of exposure of people to small particles as explored in the EXPER/PF project was integrated in a larger context of air pollution. By tackling the subject from that side, it was possible to reach people not being aware of the importance of small particles to their own particular domain and therefore impossible to touch when sticking to the smaller context. It is difficult to say what the real impact of such a communication effort is, but it was experienced that people not immediately attracted to the subject of the project as such (because of non-awareness) were touched and interested. At the information session, it was also possible to get acquainted to the database (being available in French and Dutch) and there also the observations noted were positive.

In order to present the project partners to the public, folders containing leaflets with information on partners were distributed.

4-2.4 Website

EXPER/PF website is online since the end of March 2003. The pages are included on APPA website (www.appanpc-asso.org/experpf/). All pages exist in the two languages (French and Dutch). From 2003 April 1st to 2004 December 31st, the website added up a mean of 215 connexions per month, as showed by figure 4.3.

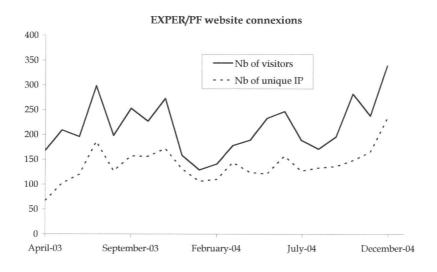


Figure 4.3 Number of connexions to EXPER/PF website

The website is divided into 8 parts:

- Presentation of the EXPER/PF project
- EXPER/PF partners

- PM measurement network in the euroregion
- EXPER/PF database
- Measurements campaigns
- Documentation
- Seminar 2003, November 28th
- Contact
- Appendix 4.1: Program of the Seminar "Air Pollution and Euroregional database: Flanders-Nord Pas de Calais"
- Appendix 4.2: Registration list of the Seminar "Air Pollution and Euroregional database: Flanders-Nord Pas de Calais"
- Appendix 4.3: Program of the Final Seminar for larger public, 2004, November 30th
- Appendix 4.4: Registration list of the Final Seminar for larger public, 2004, November 30th

Appendix 4.1: Program of the Seminar "Air Pollution and Euroregional database: Flanders-Nord Pas de Calais", 2003 November 28th (french version)



28 novembre 2003 10 h à 15 h 30

Pollution de l'air et base de données eurorégionale Flandre-Nord-Pas de Calais

10 h 00 - 10 h 20 Accueil des participants

10 h 20 - 10 h 30

Introduction, par le Pr. Richard Santer - ADRINORD

10 h 30 - 11 h 10

Présentation du dispositif fixe de mesures des PM dans l'Eurorégion Mr. Jean-Yves Saison – AREMA LM et Mr. Edward Roekens - VMM

11 h 10 - 11 h 50

Apports de la télédétection à la mesure des PM

Pr. Richard Santer - ADRINORD

11 h 50 - 12 h 30

Trans-Manche receptor-based modelling of aerosols - The first steps

Pr. K.A. Pericleous – University of Greenwich

12 h 30 - 13 h 30 Repas

13 h 30 - 14 h 15

Présentation de la base de données du projet EXPER/PF **Dr Didier Ramon** – HYGEOS

14 h 15 - 15 h 20

Démonstrations de la base de données - Discussions

15 h 20 - 15 h 30

Conclusions

Les interventions se feront en langues française ou anglaise. Afin de permettre à tous une compréhension optimale, les documents de séance ainsi que les résumés des interventions seront disponibles en anglais, français et néerlandais.



Maison Régionale de Promotion de la Santé
Salle Flandre – 4ème étage
13 rue Faidherbe – Lille
(métro Gare Lille Flandres)

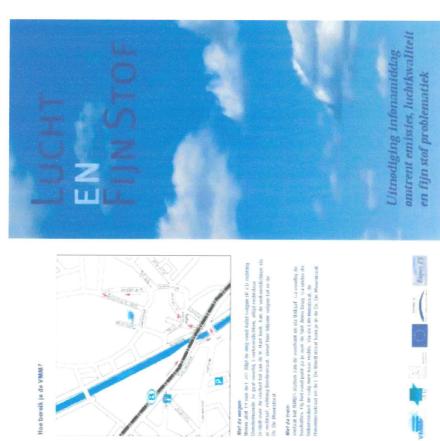


Appendix 4.2: Registration list of the Seminar "Air Pollution and Euroregional database : Flanders-Nord Pas de Calais", 2003 November 28th

Prénom	NOM	Organisme 1
Isabelle	BENDELS	Gezondheidsinspectie West-Vlaanderen
Aymeric	BLANCHET	APPA Nord-Pas de Calais
Amadou	BOKOYE	ADRINORD
Myriam	BOSSUYT	VMM
Sarie	BUFFEL	Provincie West-Vlaanderen
Jean-Pierre	COLBEAUX	CSENPC
Daniel	COULPIER	DRASS Nord-Pas de Calais
Chantal	DAUTHILLE	ADRINORD
Kristin	DE LICHTERVELDE	VLIZ
Florence	DECAUDIN	Conseil Régional Nord-Pas de Calais
Jean-Pierre	DENYS	Lille Métropole Communauté Urbaine
Pierre	DEROUBAIX	ADEME Nord-Pas de Calais
Eric	DILLIGEARD	HYGEOS
Bernard	DUHOUX	DRIRE
Birgit	DUMEZ	AMINAL - Directoraat General
Pascal	FABRE	CIRE Nord-Pas de Calais
Pascal	FASQUEL	DIREN Nord-Pas de Calais
Bernard	FOUCHER	ADRINORD
Dominique	JOLIVET	HYGEOS
Fabrice	LERIQUE	Conseil Régional Nord-Pas de Calais
Yves	LHEUREUX	SPPPI Côte d'Opale Flandre
Sébastien	LHOPITAL	Communauté d'Agglomération d'Hénin-Carvin
Christine	MATHEEUSSEN	VMM
Karine	MEERSMAN	Gezondheidsinspectie West-Vlaanderen
Dominique	MERIAUX	ADRINORD
Valérie	NOLLET	Université de Lille I
Inge	OVERMEER	Ministerie van de Vlaamse Gemeenschap
Koulis	PERICLEOUS	University of Greenwhich
Stelios	PLAINIOTIS	University of Greenwhich
Charles	POINSOT	OPAL'AIR
Didier	RAMON	HYGEOS
Edward	ROEKENS	VMM
Patricia	RUSCART	DGRNE DPA Cellule Air
Isabelle	SAGNIER	AREMA LM
Jean-Yves	SAISON	AREMA LM
Richard	SANTER	ADRINORD
Jean-Pierre	SAWERYSYN	Université de Lille I
Corinne	SCHADKOWSKI	APPA Nord-Pas de Calais
Jan	SEYS	VLIZ
Marianne	STRANGER	University of Antwerp
Ludovic	VANBRUGGHE	HYGEOS
Daniel	VERMAELEN	VMM
Jérôme	VIDOT	ADRINORD
Laurent	WANDREBECK	HYGEOS
Nicole	WINTJENS	VMM
Sophie	BONNET	CDMT
Cédric	BRUNEEL	Française de Mécanique
François	ZAGOSKY	Société Parbleu, Québec

Appendix 4.3: Program of the Final Seminar for larger public, 2004, November 30th





Appendix 4.4: Registration list of the Final Seminar for larger public, 2004, November 30^{th}

Naam	Voornaam	Instelling	
Acke	Stefan	Vlaamse Gezondheidsinspectie, Domein Gezondheid & Milieu, Elfjulistraat 45, 9000 Gent	
Bailli	Marc	Adviseur leefmilieu, Cobelpa, Louizalaan 306, 1050 Brussel	
Bendels	Isabel	Gezondheidsinspectie West-Vlaanderen	
Benoy	Sara	Gezondheidsinspectie	
Boven	Guido	Diensthoofd Milieu, Tessenderlo Group	
Calloens	Jozef	UGINE & ALZ Belgium nv	
Ceulemans	00201	Umicore - Precious Metals Refining, Departement Leefmilieu /	
	Michiel	Waterzuivering	
		A. Greinerstraat 14 - 2660 Hoboken, Belgium	
	Hana	milieu arts, Vlaamse Gezondheidsinspectie, domein Gezondheid en	
Chovanova		Milieu, Markiesstraat 1, B-1000 Brussel	
	_	Projectcoördinator, Studiedienst Vlaams ABVV, Hoogstraat 42, 1000	
Cobbaut	Ben	Brussel	
de Lichtervelde	Kristin	VLIZ	
De Ridder	Ludo	Milieucoördinator, Manager Milieubeheer	
De Vos	Anneleen	Redacteur, Jansen & Janssen Uitgeverij	
Deutsch	Felix	VITO - Vlaamse Instelling voor Technologisch Onderzoek	
Goelen	Eddy	VITO	
	Jean-		
Jacobs	Pierre	Staalindustrie Verbond, Avenue Arianelaan 5, 1200 Brussel	
Kouwijzer	Guy	ETS NV (European Tech Serv NV), Essenlaan 7, 9130 Kieldrecht	
Leleu	Tom	Mng. Milieu Veiligheid Infrastructuur, Unilin NV afd. Bospan	
Maes	Christel	Medisch milieudeskundige, gezondheidsinspectie West-Vlaanderen	
	Karine	Gezondheidsinspecteur, Diensthoofd, gezondheidsinspectie West-	
Meersman		Vlaanderen	
Oala	Henk	Application & Project Engineer, Thermo Electron Corporation,	
Oele		Environmental Instruments, Division Air Quality	
Roggeman	Katrijn	ir. AMINAL - Afdeling Milieuvergunningen	
Santer	Richard	Projectleider Exper/PF	
Schrooten	Liesbeth	VITO	
Seys	Jan	VLIZ	
Naam	Voornaam	Instelling	
Van Acker	Paul	Dienst Leefmilieu Stad Brugge	
Van Caillie	Sarah	(Responsible Care engineer) Taminco NV - Gent	
Van De Woestyne	Corry	Milieuambtenaar, gemeente Evergem-dienst PROM/milieu	
Van der Elst	Mirka	AMINAL, Sectie lucht, Phoenixgebouw, Koning Albert II-laan 19, 1210 Brussel	
Van Grieken	René	Prof. UA	
Van Lishout	Nele	Interne Milieu en Fabriekszorg, Prayon N.V.	
Van Zele	Wilfried	Schepen, gemeente Evergem-dienst PROM/milieu	
Vaneeckhoutte	Joris	NV PICANOL	
Veldeman	Herman	ARGO (E. Jacquemainlaan Brussel)	
Vliegen		Electrabel exploitatie, Kempen-Maas	
Willems	Hilde	Dienst leefmilieu -onderzoek en inventarisatie	
Zuliani	Pierre	Plant Manager, Unilin NV afd. Bospan	

NIET INGESCHREVEN MAAR WEL AANWEZIG

Naam	Voornaam	Instelling
Slootmaeker	Lieve	Afd. Milieuverg. – Aminal
Deurinck	Luk	Belgische Petroleum Federatie
Stranger	Marianne	UA
De Hoog	Johan	Milieudienst D550, BASF Antwerpen NV, Haven 725, Scheldelaan 600, 2040 Antwerpen

Van der Spiegel	Goedele	EnviroDesk
Joosen	Eddie	Gemeente Beveren

Aanwezige personeelsleden VMM

Naam	Voornaam	
Bogaert	Raymond	
Cornelis	Vanessa	
D'Heer	Miet	
D' Hondt	Philippe	
De Bosscher	Caroline	
De Brabanter	Els	
de Munter	Evelien	
De Putter	Els	
Desmedt	Marjory	
Dumollin	Jasmine	
Kayugi	Melanie	
Le Maire	Johan	
Pien	Helga	
Roekens	Edward	
Rosier	Myriam	
Smet	Katrien	
Vancaester	Kathleen	
Van den Hende	Marie-Rose	
Van Hooste	Hugo	
Vercruysse	Ronny	
Verlé	Daniël	
Verlinden	Leen	

Outlook

Three major objectives were proposed:

- (i) A transfrontier data base for PM. This tool is fully operational. Compared to what was proposed in the technical annex we did include neither the meteorological data nor the emission data. These two set of data are useful if you develop transport models for the particles. This task was not part of the EXPER/PF proposal and that one reason while we did not included these data. Second, the access to meteorological data are not always free of charge (it was not budgeted in EXPER/PF) and about the emission the access to the information was not straightforward.
- (ii) A pilot study around Lille. It was a salient success of this project as it is demonstrated in the relevant reports.

EXPER/PF permits to establish good relationships between the air quality monitoring networks from Nord Pas de Calais and Flanders

By the intercomparison, it permits to verify that the measurements are comparable on each side of the border. It shows the plume effect coming from Lille Metropole towards the Flanders concerning nitrogen oxides.

(iii) Awareness actions to different publics through the creation of bilingual tools (brochure, website) and through the organization of two seminars: the first one in order to present the database to professionals and the second one for general public information (press conference).

Scientific/technological quality and innovation

The scientific and technological qualities of the project are the highest following states of the art in the different domains: remote sensing, analytical chemistry, The innovation was significant as shown by the list of scientific publications relevant to the project.

Community added value and contribution to EU policies

The European dimension of EXPER/PF is directly derived first from the goal, which is to use EO as a tool for environmental monitoring. Of course, environmental issues are trans-national. Quite often, EO contributes to the standardisation of the observations and of the measurement protocols.

EXPER/PF contributes to facilitate the information for the individual citizen in the environmental domain; directly but in enabling local authorities to use the SISCAL service. SISCAL is in line with EC key actions: Intelligent Environmental Management, Pollution surveillance and control, Development of new long-term objective.

Contribution to Community social objectives

EXPER/PF contributes to improve the quality of life through indirectly enhancing the environment by providing synoptic views on its actual state. In terms of economical issues, EXPER/PF participated to the growing field of commercial services based on the use of EO.

Economic development and S&T prospects

EXPER/PF will survive on year 2005 thanks to HYGEOS. It will be maintained as a service element for the ATTMA project (Kent-NPdeC Interreg 3-a project). A new Interreg 3a project ISECA (Flander-NPdeC) was submitted in 2004. This project dealing with the Eutrophisation of the coastal waters will rely on the technical achievement of EXPER/PF. The commercial strategy is to maintain the service as long as possible and to respond to any Announcement of Opportunity for which the EXPER/PF processor is needed.

Relations and synergies with other relevant projects

The relation with ATTMA is very relevant because the EXPER/PF data base is used and simply covers a broader area. The above mentioned ISECA project is based as well on further developments of EXPER/PF.

How the results and achievements of the project have benefited each partner and how the partners intend to use and exploit these further?

For ADRINORD, it was quite important to coordinate an European project in order to learn how to administrate such a project. This positive experience is an encouragement to respond to announcements of opportunity released by the European Commission.

One more scientific or technical issues, the participation to EXPER/PF contributed to improve the ADRINORD/ULCO expertise. More generally the scientific expertise of ULCO will be made available to future development of EXPER/PF which is already the case within the INTERREG-3 ATTMA project between the UK and France.

HYGEOS is happy with the result as it yielded a somehow unique operational tool with real scientific and technological development. It allows HYGEOS to demonstrate his know-how in the field of remote sensing and web based application development oriented toward environmental issues. Some important users have progressively registered on the site. They originated from various sectors (ADEME, Conseil Régional NpdC, INERIS, Université de Lille I, PSA...). We hope EXPER-PF has made these potential clients/partners more sensitive to the benefits they may expect in their missions from Earth Observation data combined with information technologies. We plan to keep running and maintain the tool at least for one year after the end of the project in order to use it for research applications, for example in Public Health (a research programme proposal has been formulated with APPA and CIRE in France). The database is sufficiently rich to contribute to the explanation of pollution episodes in the past and we plan to use it with other partners to help model aerosol transport in the euro-region.

For AREMA, the creation of the data base permits to examine in a unique time the evolution of PM concentration on both sides of the border. This is a help in the interpretation of data in qualifying the pollution events as a macro scale or a micro scale event. Secondly, the experiments of VMM in the

measuring of dioxins will be very interesting for AREMA to put in place the measurements of theses compounds around Lille metropole.

OPAL'AIR will use the project to extend its PM2.5 measurement network by two stations newly equipped.

For APPA, EXPER/PF project was a first experience of transborder collaboration. Thanks to the project, and specially to the shared tasks with VLIZ, we have realised some bilingual tools: brochure and website. We have also taken advantages of contacts with our EXPER/PF flemish partners for others communication actions (seminar announcements,...). We plan to carry on the project, in the framework of research project (with HYGEOS and ADRINORD) concerning PM modeling. We will also continue to exchange informations with our flemish partners.

Thanks to the EXPER/PF-project VMM obtained extra results of the PM-values at Menen and Kortrijk, of the amount of dioxine- and PCB126-deposition at Menen and of many other pollutants (PAH, ...). Also information on the ratio of the PM10/PM2.5 concentrations were obtained in this environment. At Menen high depositions of dioxine and PCB126 were found. Extra measurements nearby similar factories, proved that shredder installations are a source for dioxine and PCB126. Through the campaign with the passive samplers in West-Vlaanderen, we got an idea of the dispersion of NO₂ and BTEX on a provincial scale and we found a clear difference in concentration depending on the type of location

The measurements of PM and dioxines and PCB126 in Menen are still continued.

The comparability of the measurements between the networks of AREMA/LM and VMM was studied and proved to be acceptable.

Information on the correction factors between the automatic monitors (TEOM) and the manual gravimetric methods was exchanged. A different approach in France and Belgium (Flanders) is applied.

A common measuring programme to study the influence of the Lille Metropole on the environment was organised by using mobile laboratories. Experience with the measurements was exchanged.

For UA, the measurement campaign with passive samplers in West-Flanders has lead to an identification of local, seasonal and geographical influences on the ambient NO₂ concentrations in a relatively small area. It also offered an opportunity to evaluate the effectiveness of the telemetrical network of VMM, in estimating the NO₂-levels all over Flanders by means of modeling programs. In Menen a wide range of pollutants has been studied. The combination of all this information has lead to a clear view on various gaseous species, PM2.5 and its inorganic and organic components, in one fixed location. Combining these data with backward trajectories proved the large-scale influences on the local air pollution in Menen. Heavy metal contamination apparently originated mainly from Germany and United Kingdom. No proof of heavy metal contamination due to the industrial area in the surroundings of Lille has been established.

6. Conclusion

The EXPER/PF service exits. It first results from a knowledge transfer from Research institutes to a small company, HYGEOS, even if key personnel have a strong academic research background. The EXPER/PF processor realization was quite a challenge for a small company and to be able to go through was a rich experience. A three years project is too short to fully develop a service.

On the quality of the service, a positive feedback, even a little one, was provided by external end users. The general limitations are well known:

- (i) the state of the art is still not good enough for PM remote sensing. The relevant skills are in the EXPER/PF consortium. Improvements are expected to be brought within ATTMA.
- (ii) the access to the EO data is critical. To improve this task, a deeper collaboration with ESA should be a real plus.
- (iii) The concept of making money with the EO is a liberal one. On practical basis, the potential customers in this field are mostly public. Support from public institutions are needed.

The collaboration between AREMA, VMM and UA results in a success of the pilot study.

Communication is always challenging. Close collaboration between APPA and VLIZ allowed the production of bilingual tools (4 pages brochure, website). The website will be maintained for general public after the end of the project (www.appanpc-asso.org/experpf/).

A two years project (plus one for preparation) is two short in time to fully realize operational objectives. The success of EXPER/PF partially results of the collaboration between some partners across the border already started during INTERREG-2. It should be good to apply to the second phase of INTERREG-3a. It is still an option for a project in which the link between emission and reception (PM measurements) can be established trough transport models. It is needed as well to associate new partners as well as Health Authorities in the ultimate goal to propose suitable indices for epidemiologist studies.