Syrian Arab Republic

E.S.R.C.

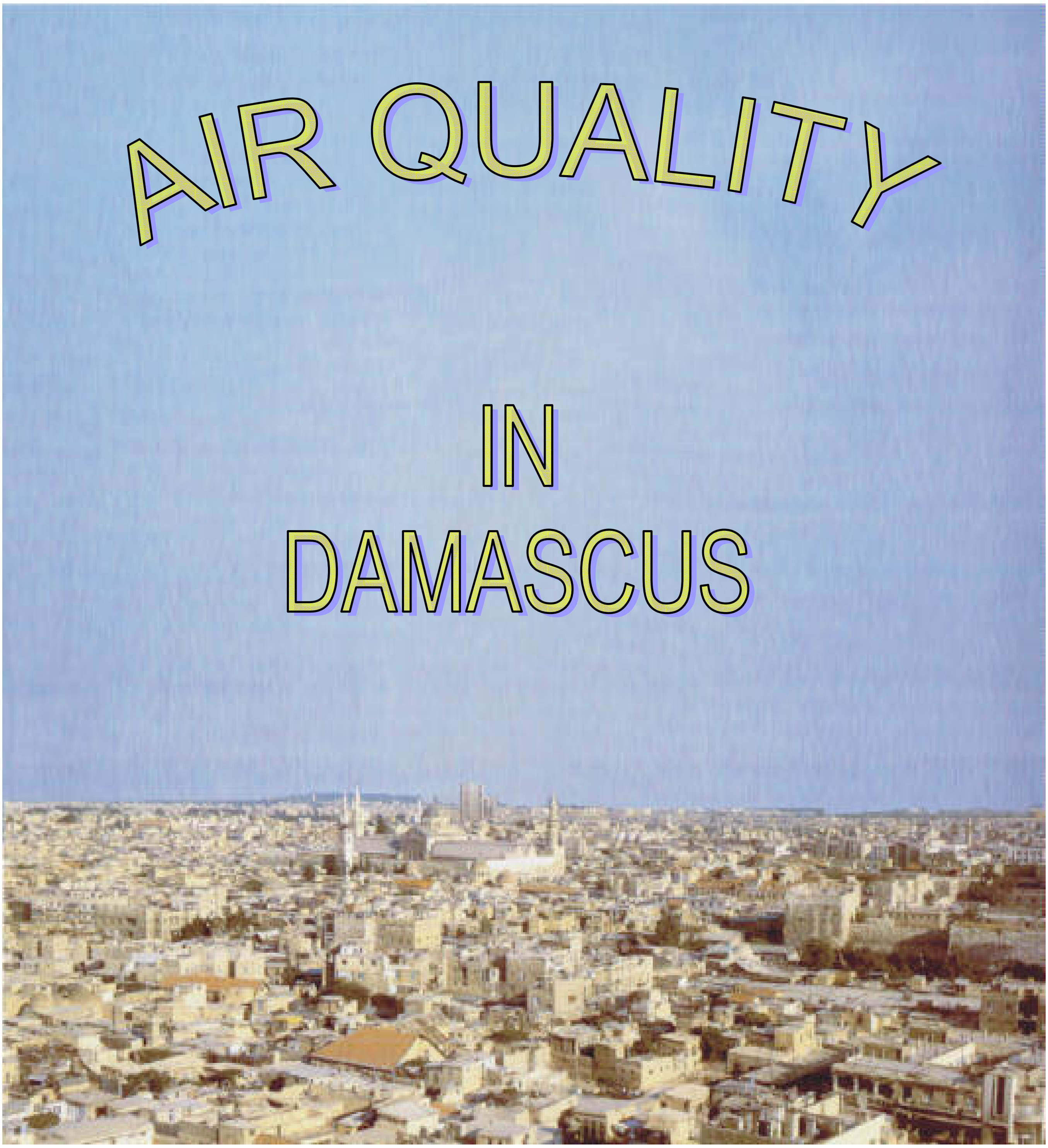
Environmental & Scientific
Research Center

AECS

Federal Republic of Germany

Deutsche Gesellschaft für
Technische Zusammenarbeit mbH

AIR QUALITY IN DAMASCUS



Damascus
2000

E.S.R.C

AIR QUALITY

in

DAMASCUS

Project of Technical Cooperation

between the

Syrian Arab Republic and the

German Federal Republic

Preparation of an air quality monitoring program Damascus

Damascus

2000

Prof. Dr. Mahmoud Saleh Soliman
(Director of E.S.R.C.)

Project Manager
Dr. Yousef Meslmani
(Atomic Energy Commission of Syria, Department of Protection and Safety)

German Consultant
Werner Habbel
Senior Consultant
(Dr. Krätzig Ingenieurgesellschaft mbH)

Project Coordinater at E.S.R.C.
Anaam Jalila
Jaber Ali
(E.S.R.C.)

Working Team of E.S.R.C.:

Ali Salameh
Ahmed Kamel
George Hawashi
Nidal Al-Homsi
Hanaa Moustafa
Rim Zgibh
Abir Hasan
Mohamed Saleh
Ali Issa
Rawnak Jabbour
Ghada Hussein
Magida Daoud
Bassam Hasoun
Nada Saoud
Thanaa Hasan

Working Team of Governorate of Damascus:

Wadiah Jouha
Nawaf Derrah

Digital Map of Damascus was provided by Remote Sensing Agency, Damascus

Contacts:

E.S.R.C.
Environmental & Scientific Research Center

Damascus, Mazzeh-Western Vilas
P.O. Box 36782
Syria
Tel.: ++963 11 6115719
Fax: ++963 11 6622309
Email: esrc@mail.sy

GTZ
Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH
Dag-Hammarskjöld-Weg 1+2
65726 Eschborn
Germany
Tel.: ++49 6196 790
Fax: ++49 6196 791115

AECS
Atomic Energy Commission of Syria
P.O. Box 6091
Syria
Tel.: ++963 11 6111926
Fax: ++963 11 6112289
Email: atomic@net.sy

Dr. Krätzig Ingenieurgsellschaft mbH
Süsterfeldstrasse 81
52072 Aachen
Germany
Tel.: ++49 241 889730
Fax: ++49 241 8897328
Email: dr.kraetzig-ing-gmbh@t-online.de

Foreword

Environmental problems interrelated with many political matters and are often caused by unsuitable modes of development. Therefore, we cannot define the framework of environmental measures and goals without also considering the development sectors and policies from which they derive their roots.

In light of this background, it is necessary to define a work plan for environment in Syria in general, and in Damascus in particular. The most important recommendations in this plan relate to environmental evaluation (surveying, researching, monitoring, information exchange, environmental management, support measures, training, public awareness, financing, technical co-operation).

The environment has always been one of the main interests of all people and views and attitudes towards environmental matters have developed throughout the centuries.

At the beginning of the 20. century, the environmental movement was a synonymous with wild life preservation and it was only of interest to a few of people. Since the beginning of the 1960s the environmental movement has become a movement with very wide interest and support. Growing public pressure at the end of the 1960s and the beginning of the 1970s supported by scientific results concerning the effects of different pollutants and environmental deterioration caused the necessary political interest. Also the discussions in the beginning of the 1970s which focused on water and air pollution, supported the fact that environmental deterioration is not only the result of industrialisation but also of poverty and the lack of development. The environmental movement began to include all aspects of the natural environment: earth, water, air (atmosphere), climate, life processes, polar and ice rivers, ocean depth, and outer-space.

In addition the environmental movement has stopped looking at the natural environment independently of other factors and has started to examine its interrelations with humans and their welfare. International economic co-operation, including matters of debts and other matters which cannot be mentioned here, have also started to be considered.

The air pollution problem, especially in the major cities, can be considered one of the most important problems facing human settlements in recent centuries.

Damascus city is considered to be one of the main cities in the Arab Homeland and east of the Mediterranean. It has had a large population increase in the last two decades and has reached a population of approximately four million.

As a result of this population increase, all facilities increased and all industrial production sectors grew. Therefore it is necessary to investigate the air pollution problem in Damascus, in order to find the cause of the pollution and find possible ways of treating the problem.

In the last two decades, there were many trials that studies air pollution in Damascus, but these trials were irregular and incontinuous. The last monitoring of air pollution in Damascus was at the end of the 1980s and the beginning of the 1990s. For this reason it was necessary to carry out a modern study according to international scientific principles. Motivated by these concerns, the Environmental & Scientific Research Center carried out a project of air quality monitoring in Damascus and was supported by the German Agency for Technical Cooperation GTZ within the framework of the agreement signed by the two governments on the 04.03.1998 (Urban Industrial Environmental Protection Program).

The study focussed on the emission resources inventory and the evaluation of the current status of air quality by using an advanced modern monitoring system to measure dust and gases (CO, NO_x, SO_2). The results of the measurements were then analysed. The results obtained can be used as a starting point from which to develop the environmental policies. Some of the numbers obtained show that pollution in some areas of the city exceeds the international standards, and the majority of the results in other sites are also below the international standards

The report makes some recommendations for possible ways of reducing the emissions. We hope that decision makers have enough interest in the health of our environment and our citizens safety that they take our recommendations into account. These recommendations, it put into action, would keep our sky clean and aid in the recovery of the environment.

Finally, I would like to extend my thanks to:

- The Government of Federal Republic of Germany for the technical support represented by GTZ.
- Dr. Krätzig Engineers Ltd. represented by Mr. Werner Habbel for the expertise it provided.
- Damascus Governorate for its beneficial co-operation.
- The General Organisation for Remote Sensing for its co-operation in providing the digital map.
- The General Directorate of Metrology for its co-operation.
- Atomic Energy Agency represented by Dr. Yousef Meslmani for its beneficial co-operation.
- The staff of the Environmental & Scientific Research Center especially the technicians and laboratory staff for their continuous efforts.

Damascus 2000

Head of Project

Prof. Dr. Mahmoud Saleh Soliman
General Director of ESRC

Contents

Summary

The bilateral project of co-operation between Syria and Germany, namely the "Preparation of an air quality monitoring program Damascus" began in 1998. The main objective of the project was the first consistent evaluation of the air quality in Damascus. The results of this evaluation are intended to be used to draft a future programme for monitoring the air quality in Damascus.

To achieve the mentioned objective, a pilot air quality monitoring programme was designed and carried out in the city of Damascus from October 1999 to November 2000. A first coarse emission inventory concentrating on three representative regions of the city of Damascus was established for the reference year 1996 in order to support the air quality evaluation. The inventory was elaborated for two pollutants; sulphur dioxide (SO_2) and carbon monoxide (CO) and was separated into the fields of the transport, residential and commercial/industrial sector.

Based on the available data of vehicles, the inventory concerning the transport sector covered the whole Damascus region. In total an annual emission of 6.3 kt SO_2 and 149.7 kt CO was estimated for 1996.

For the emission inventory for the residential and commercial/industrial sector, surveys of fuel consumption were undertaken in 6 quarters of 3 regions in Damascus: Saruja, Ukaiba, Akssab, Bilal, Daumne/Karaune, Mashro Dummar. The results of the estimate of the emissions for these areas were: 0.3 kt/a SO_2 and 3.5 kt/a CO.

The pilot air quality programme was executed by using advanced technologies of monitoring. The main part of the monitoring was done by using automatic analysers which were installed in a container on a truck (Mobile Unit). This way, it was easily possible to relocate the monitoring equipment in various sites throughout Damascus. In some locations where it was not possible to set up the Mobile Unit, electronic controlled gas sampling systems were installed. In these cases the sampled pollutants were analysed later in the ESRC laboratory.

In order to obtain widespread information about the air quality in Damascus 15 monitoring sites were selected. These sites are representative of different areas in Damascus. Five air pollutants were selected to be monitored: total suspended particulates (TSP), sulphur dioxide (SO_2), nitrogen monoxide (NO), nitrogen dioxide (NO_2) and carbon monoxide (CO). Besides the analysers for concentration measurements, the Mobile Unit is also equipped with monitors for wind direction and wind velocity. A total number of 39208 valid concentration values and meteorological data was obtained. This data was used for further processing and evaluation.

Total suspended particulates (TSP)

At most of the monitoring sites the average concentration of TSP was in the range between 200 µg/m^3 and 300 µg/m^3. The highest average concentration (369 µg/m^3) was observed at the monitoring site BT2 at the Bab Tuma Square. At the same site the highest 24-h value was also measured. The lowest average concentration (86 µg/m^3) was obtained at the monitoring site MJ3 at the Khorshid Square in Muhajrin. The lowest 24-h concentration value was also measured at the MJ3 site.

The TSP average concentrations obtained at 13 monitoring sites exceeded the annual standards established in the Syrian Proposal for Air Quality Standards (90 µg/m^3) and in the German regulations (150 µg/m^3). Only at the MJ3 monitoring site the average concentration (86 µg/m^3) was below the standards.

The 24 hours standard in the Syrian Proposal (150 µg/m^3) was also exceeded at all monitoring sites with the exclusion of MJ3. At 9 of the monitoring sites even the minimum 24-h average concentration was higher than this standard. In total, 84 % of the measured 24-h concentration exceeded this standard.

In general there was no significant difference between the TSP concentration obtained at monitoring sites in the streets and inside residential areas. Concerning the composition of the particles sampled at the different sites, an evident difference could be observed during the monitoring although an analysis of the components was not undertaken. The particles sampled in the streets were black and fine. At the other monitoring sites the particles were not so dark, some were even light brown and coarse at those sites which were not influenced by heavy traffic. The most important origin of the fine black particles in the streets are the vehicles: fuel, especially diesel, combustion and the loss of rubber from the wheels. The bright sand-coloured particles which were the main particles at the monitoring sites away from the streets are presumably of natural origin or from construction sites.

Sulphur dioxide (SO_2)

The average concentration of SO_2 at most of the monitoring sites lay between 10 µg/m^3 and 50 µg/m^3. The highest averages were obtained at the monitoring sites BT2 at the Bab Tuma square and MJ2 and MJ3 in Muhajrin. These high concentrations were observed during the monitoring in October and November 2000. The lowest average concentration of SO_2 was measured at the monitoring site DUM in Dummar.

The average concentration of SO_2 determined at the monitoring site at Bab Tuma square exceeded the annual standard of the Syrian Proposal (80 µ/m^3). The annual standard established by the World Health Organisation-WHO (50 µ/m^3) was exceeded at Bab Tuma square and at the two monitoring sites in Muhajrin. At the other monitoring sites the concentration reached between 10 % and 76 % of these standards.

The 1-h standard established in the Syrian Proposal and European directives (350 µg/m^3) was exceeded twice at the monitoring site at Bab Tuma square. The 1-h values determined at the other monitoring sites were between 15 % and 67 % of this standard.

The established 24 –h standard (125 µg/m^3) for SO_2 was exceeded by 55 % of the values at the monitoring site at Bab Tuma square. At the monitoring site in Tijara the highest 24-h values reached 89 % of this standard. At all other sites the highest 24-h concentration lay in a range of 22 % to 66 % of the standard.

Nitrogen dioxide (NO_2)

The highest average concentrations of NO_2 (73 µg/m^3 to 84 µg/m^3) were obtained at the monitoring sites which suffer from heavy traffic: Yousef Al-Azmeh square, Baramikeh and Bab Tuma square (BT2). At the other monitoring sites the average concentrations lay between 24 µg/m^3 and 56 µg/m^3. The lowest value (24 µg/m^3) was observed at the monitoring site DUM in Dummar.

The annual standard for NO_2 concentrations established in the Syrian Proposal (100 µg/m^3) was not exceeded. The standard for annual averages established by the WHO and the European Union (40 µg/m^3) was exceeded at all monitoring site with the exception of Midan, Dummar and Dwella.

The standard for 1-h concentration in the Syrian Proposal (400 µg/m^3) was not exceeded. The European and WHO standard of 200 µg/m^3 was exceeded at Yousef Al-Azmeh square (2 values) and Dummar (1 value).

The standard for 24-h concentration established in the Syrian Proposal (150 µg/m^3) was not exceeded.

Carbon monoxide (CO)

The lowest average concentrations of CO (0.5 mg/m^3 and 0.3 mg/m^3) were obtained at the monitoring sites in Dummar and Dwella, and the highest concentration (10.9 mg/m^3) at Bab Tuma square. At the other sites the average concentration lay between 1 mg/m^3 and 5 mg/m^3. At almost all monitoring sites the minimum 1-h averages were below the detection limit of the analyser (0.1 mg/m^3). Only at the Yousef Al-Azmeh square and Bab Tuma square even the lowest values were higher than the overall averages at some of the others sites.

The 1-h standard of 30 mg/m^3 was not exceeded. The determined 1-h concentrations reached 16 % to 67 % of this standard.

The 8-h standard established in the Syrian Proposal and by the WHO (10 mg/m^3) was exceeded at the monitoring sites at Bab Tuma square and in Tijara. In regard to the calculated 8-h average concentrations, 40 % of the results exceeded the standard at BT2 and 5 % at TIJ. At all other sites the 8-h average concentrations lay between 17 % and 80 % of the standard.

General

In order to get an average concentration value for the complete monitored area, the average concentration of pollutant of all monitoring sites was calculated. These overall averages are shown in the following figure. The overall average of TSP was 246 µg/m^3, of SO_2 39 µg/m^3, of NO_2 49 µg/m^3 and of CO 2.8 mg/m^3.

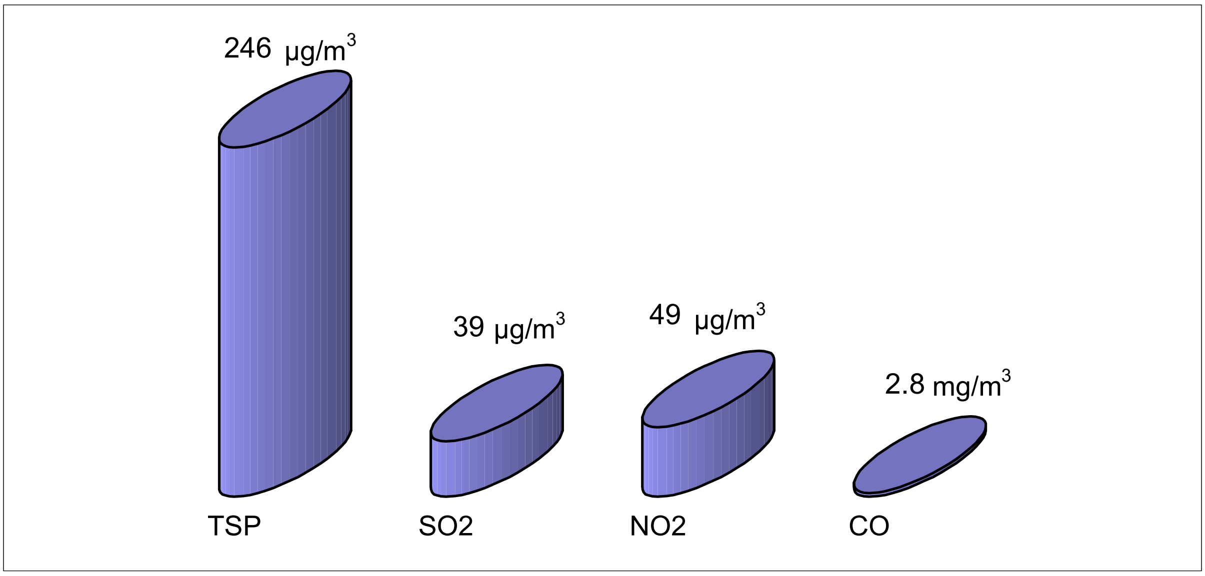


Figure: Average concentrations of total suspended particulates (TSP), sulphur dioxide (SO_2), nitrogen dioxide (NO_2) and carbon monoxide (CO) in Damascus in 2000.

The monitoring presented was mainly executed during summer. The contribution of emissions by heating, which is one of the main sources of air pollution in Damascus could therefore not be considered. For this reason, it can be assumed that the concentrations of the monitored air pollutants will probably be higher in winter. This will also increase also the long-term averages.

All diurnal variations of the gaseous pollutants showed comparable shapes: one peak in the morning and one in the evening. This corresponds to the increase in traffic at these times. During the day the concentration stayed of a relatively constant level, which was higher at traffic influenced monitoring sites than at sites in residential areas. All this indicates traffic as the main source of the air pollution detected during the monitoring.

In wintertime a ground based thermal inversion can be observed in Damascus. In the morning, at sunrise, the ground air layers are warmed up later than the higher levels and the vertical exchange of air is suppressed.Therefore an inversion layer with a stable meteorological condition can be observed. In such an inversion layer the pollutants are trapped and the dispersion is constrained.

The monitoring sites in Muhajrin were situated at the beginning of the incline of the Casyoun Mountains, and were above the level of the other monitoring sites. In the morning hours when the inversion layer raised, the pollutants, which were emitted in the city and kept within the inversion layer, were transported to higher levels and reached the monitoring sites located higher. Therefore, this transported pollution could contribute to the monitored concentrations at those higher monitoring sites. The high concentration peaks at these sites lasting for about 1 hour in the early morning support this assumption.

In order to get a summarised view of air pollution the average concentrations of the pollutants at each monitoring site were added. The monitoring site at Bab Tuma square was identified as the most polluted one, followed by the sites in Muhajrin and the 'traffic sites' Yousef Al-Azmeh square and Baramikeh.

Based on the results of the emission inventory and the air quality monitoring in 1999 and 2000, and considering former air quality information, basic recommendations for an air quality management programme in Damascus were established.

List of tables

Page

List of figures

1 Introduction

In 1998 the bilateral project between Syria and Germany, the “Preparation of an air quality monitoring programme Damascus” started. In Syria the Environmental & Scientific Research Center (ESRC), in collaboration with the Governorate of Damascus, and with the support of the Syrian Atomic Energy Commission, was responsible for the execution of the project activities. On the German side the German Society for Technical Cooperation (GTZ) was responsible for the execution of the project. The GTZ commissioned the Dr. Krätzig Ingenieurgesellschaft mbH (Dr. Krätzig Engineers Ltd.) with the realisation of the defined project activities.

The main objective was to produce the first consistent evaluation of the air quality in Damascus. The results of this evaluation are intended to be used to draft a future programme for monitoring the air quality in Damascus. Besides this technical objective the defined activities included the supply of monitoring equipment, the transfer of knowledge about air quality monitoring, and the implementation of air quality management methodologies.

To achieve the mentioned objective, the project partners agreed upon an operation plan in which the activities to be executed in the framework of the project were defined. The majority of the activities were connected with the designing, execution and evaluation of a pilot air quality monitoring programme in the city of Damascus. To support the air quality evaluation, a second set of activities was undertaken, namely an emission inventory.

The objective of the pilot air quality monitoring was the short-term investigation of the air pollution in different representative parts of the city. For the execution of the monitoring, equipment for air sampling, laboratory analysis and data processing were provided as well as a Mobile Unit. This unit was equipped with automatic measuring devices for continuous air quality monitoring. The pilot monitoring took place in the period from October 1999 to November 2000. The monitoring, analysis and evaluation were undertaken by the ESRC.

The emission inventory study concentrated on three representative regions of the city of Damascus and considered the main objective of this part of the project, to be the implementation of inventory methodologies. The results of the inventory should serve to support the findings of the evaluation of air quality but also as a base for further increased and detailed studies. The emission inventory was elaborated by the ESRC in co-operation with the Governorate of Damascus.

The present report describes the monitoring programme and the emission inventory, discusses the obtained results and proposes further activities of air quality management in Damascus.

2 General information

In the following paragraphs some of the basic terms will be explained to facilitate the understanding of the present report.

Air Pollution

Air pollution is commonly defined as any change of the natural composition of ambient air by increasing or decreasing the quantity of natural compounds or by adding other components like smoke, soot, gasses, steam or odours. These changes could be caused by ‘natural’ processes like emissions of particles, sulphur dioxide and mercury of volcanic eruptions or desert storms. Main anthropogenic causes of air pollution are traffic, firings and industrial processes. To identify any change of air composition, it is necessary to know the ‘natural’ composition of air, which is given in table 1.

Table 1: Natural composition of air [17].

Nitrogen (N_2)	78.1 %
Oxygen (O_2)	20.93 %
Argon (Ar)	0.9325 %
Carbon dioxide (CO_2)	0.03 %
Neon (Ne)	0.0018 %
Helium (He)	0.0005 %
Krypton (Kr)	0.0001 %
Hydrogen (H_2)	0.00005 %
Xenon (Xe)	0.000009 %
Ozone (O_3) (Troposphere)	0.000002 %

All substances which alternate the mentioned composition of ambient air are called ‘air pollutants’. Typical air pollutants are:

- Sulphur dioxide (SO_2),
- Nitrogen oxides (NO, NO_2),
- Carbon monoxide (CO),
- Hydrocarbons (HC,
- Particles,
- Ozone (O_3),
- Benzene and
- Soot.

Emission

Any launch of material or energy from sources into the environment is called ‘emission’, i. e.: gases, particles, heat, sound.

The location where the emission appears from is called ‘emission source’. Usually the sources are divided into four categories:

Point Source

These sources allow an exact determination of emission location, quality and quantity. An example is a chimney.

Area Source

These are sources which cannot be restricted to one single defined point. Examples for this kind of source are open pit areas or storage areas. Also a number of point sources together could form a huge area source, for example urban areas or production plants.

Line Source

These sources are neither point nor area source. The most important line source in air quality studies are traffic roads.

Diffuse Source

These sources do not have an exact location or defined emissions, examples are leakages, open doors or gasoline stations.

Air Quality

Air quality describes the type and quantity of components in ambient air. While emission studies monitor and evaluate the air pollutants at the location of launching, the air quality studies identify the type and quantity of components in ambient air in order to evaluate the impact of air pollutants on the receptors like human beings, animals or plants. As a tool for air quality evaluation, standards and guidelines for air quality were established. One of the essential criteria for the establishment of air quality standards are the effects that the different air pollutants have on the health of people.

Effects of Air Pollutants

The pollutants in ambient air could be classified into gases and particles which include solids and liquids. The emitted gases (primary pollutants) disperse in air like the natural air components. Corresponding to the chemical reactivity and the ambient conditions, the gaseous pollutants sometimes react with one another and form new pollutants (secondary pollutants) like ozone.

The particulate pollutants are divided into ‘respirable’ particles with diameters below 10 µm (PM_{10}) and ‘non-respirable’ particles with diameters above 10 µm. The bigger particles deposit faster than the smaller ones, and their effects can therefore be observed near the emission sources. Small particles sometimes behave like gases and remain in air for a long time.

Total Suspended Particulates (TSP)

All particles in air combined together are called as total suspended particulates. Considering the methods for measuring applied, all particles diameters up to 100 µm were monitored. These particles have no unified chemical composition. They differ concerning the type of solid nucleus (Carbon, minerals etc.) and also concerning the substances adsorbed on the solid nucleus. Effects on health are mainly caused by the respirable particles which enter into the bronchites and lung. The main effects are:

– The particles themselves effecting breathing,,
– cancer and other effects on health caused by the toxic substances absorbed through the particles,
– catalytic effects on gaseous pollutants.

Sulphur dioxide (SO_2)

Sulphur dioxide can provoke all kinds of respiratory diseases like reduction in the mean forced expiratory volume, wheezing or shortness of breath. total respiratory causes and chronic pulmonary disease.

Under certain conditions SO_2 is oxidised to SO_3 in the atmosphere. SO_3 combines with the atmospheric humidity to produce sulphuric acid (H_2SO_4) which is a strong mineral acid able to attack even stones and metals. This acid is also one of the main pollutants out of which the acid rain is composed.

Nitrogen Oxides (NO_x)

The main sources of nitrogen oxides are any kind of firing. The principally emitted pollutant is nitrogen monoxide (NO) which is rapidly (in the scale of minutes) oxidised to nitrogen dioxide (NO_2) and other highly oxidised nitrogens. Therefore, air quality studies only take NO_2 into consideration.

NO_2 causes respiratory diseases and can form nitrosamins under reaction with organic amino acids. Nitrosamins are highly cancerogenic components. With water, NO_2 forms nitric acid, a strong mineral acid.

Carbon Monoxide (CO)

Carbon monoxide is one of the respiratory toxins. Its high affinity to haemoglobin in blood causes a rapid combination of CO and haemoglobin. Due to this combination haemoglobin cannot transport oxygen and stops the oxygen supply of the organs.

Air Quality Standards and Guidelines

Considering the effects that air pollutants have on health, the state-of-the-art of emission control and monitoring technologies, various governments and environmental institutions established guidelines and standards for air quality relating to a list of priority pollutants. These guidelines and standards can be used to evaluate the air quality based on measured pollutant concentrations.

In the present report, guidelines and standards proposed by the Syrian High Commission for Environmental Safety, established by the World Health Organisation (WHO), the European Union (EU) and the German Government are used for comparison with the obtained results.

Syrian Proposal

In 1993 the Syrian High Commission for Environmental Affairs launched a "Proposal of Syrian Standards for Air Pollutants (atmosphere)"[1]. This proposal includes standards for six air pollutants: carbon monoxide, ozone, nitrogen oxides, sulphur oxides, total suspended particulates and lead. The standard values defined are based on the standards established by the WHO and the International Labour Organisation (ILO), and consider both the results of monitoring campaigns executed in some Syrian Cities in 1985 by the ECOPOL company and the regional climate conditions.

European Union (EU)

The European Union established directives defining standards for various air pollutants in order to unify the air quality legislation in member countries. The directive 80/779/EWG defines standards for sulphur dioxide (SO_2) and particulate matter (TSP), the directive 85/203/EWG for nitrogen dioxide, and the directive 92/2/EWG for ozone.

In 1996 the EU started to revise their air quality standards and in 1999 the first revised directive (1999/30/EG of 22. April 1999 about the concentrations of sulphur dioxide, nitrogen dioxide and nitrogen oxides, particles and lead in air) [6] was launched.

WHO

In 1989 the WHO published 'Guidelines for Air Quality in Europe'. A revised edition was launched in 1999 [2]. Like the air quality standards of the EU, the WHO guidelines were established for the minimisation or avoidance of any effect of air pollution on health.

Concerning particles, the WHO studies concentrate on particles with diameters less than 10 µm (PM_{10}). Due to the lack of exact data about the effect of those particles on health, the WHO has until now resisted establishing new guideline values for this air pollutant.

German Standards

In Germany the principal air quality standards consiste of three legal regulations: the 'Technical Instructions on Air Quality Control' (TA Luft) [3], the 22nd and the 23rd Ordinance of the Federal Immission Control Act (22. BImSchV, 23. BImSchV) [4,5].

The TA Luft established in 1986 includes air quality standards for the evaluation of air quality in regard to the licensing procedures for industrial installations. The standards were defined to protect human beings against the impact of pollution caused by industrial installations.

The 22nd BImSchV implements the European standards for SO_2 and TSP (directive 80/779/EWG), nitrogen dioxide (directive 85/203/EWG) and ozone (directive 92/2/EWG), into German legislation.

The 23rd BImSchV established air quality standards for nitrogen dioxide, benzene and soot for the evaluation of air quality monitoring inside roads.

Because all of the mentioned standard and guideline regulations are adjusted to state-of-the-art technologies and scientific progress, the listed values can be revised. The actual status of standards and guidelines is given in table 2.

Table 2: Air quality guidelines and standards.

Pollutant		Guideline/ Standard µg/m³		Reference
Sulphur dioxide (SO_2)				
	1-h average	350		Syrian proposal
	24-h average[1]	125		Syrian proposal
	annual average	80		Syrian proposal
	annual average[2]	140	IW1	TA Luft
	98 percentile[3]	400	IW2	TA Luft
	1-h average	350		EU
	24-h average	125		EU
	annual average (vegetation)	20		EU
	1-h average	500	alert	EU
	24-h average	125		WHO
	annual average	50		WHO
Total suspended particles (TSP)				
	24-h average	150		Syrian proposal
	annual average	90		Syrian proposal
	annual average	150	IW1	TA Luft
	98 percentile of 24-h averages	300	IW2	TA Luft
	annual average	150		22. BImSchV
	95 percentile	300		22. BImSchV
Nitrogen dioxide				
	1-h average	400		Syrian proposal
	24-h average[4]	150		Syrian proposal
	annual average	100		Syrian proposal
	annual average[2]	80	IW1	TA Luft
	98 percentile[3]	200	IW2	TA Luft
	98 percentile	200		22. BImSchV
	98 percentile	160		23. BImSchV
	1-h average	200		EU
	annual average	40		EU
	1-h average	400	alert	EU
	1-h average	200		WHO
	annual average	40		WHO
Carbon monoxide (CO)				
	1-h average	30000		Syrian proposal
	8-h average	10000		Syrian proposal
	annual average[2]	10000	IW1	TA Luft
	98 percentile[3]	30000	IW2	TA Luft
	15-min average	100000		WHO
	30-min average	60000		WHO
	1-h average	30000		WHO
	8-h average	10000		WHO

notes:

[1] should be exceeded only three times a year,
[2] characterising long-term impact,
[3] characterising short-term impact,
[4] should be exceeded only twice a year.

3 Emission inventory

3.1 Introduction

The purpose of an emission inventory is the identification and description of type and quantity of emissions in a distinct area. The most exact and detailed air emission data is obtained by measurements of the emitted pollutants at the emission sources. Due to the cost and the time consumed by such comprehensive monitoring programmes even in small areas, the emissions are mostly estimated by calculations based on pilot measurements, emission factors and other basic surveyed data.

The elaboration of the first crude emission inventory in the framework of the technical co-operation project "Preparation of an Air Quality Monitoring Program Damascus" will not provide comprehensive data about emissions, but will identify the contribution of the main emission sources in representative regions of Damascus. The methodologies implemented during this first inventory approach provide the basis on which more detailed air emission inventories can (and should) be undertaken in the future.

Carbon monoxide and sulphur dioxide were selected as pattern pollutants. The estimation methods for these pollutants are representative for the principal methods of estimation procedure: application of 'emission factor calculations' and 'material balance'. Besides this, both pollutants are emitted by all the main emission sources in Damascus, which allows a comparison of the different source types.

Damascus City includes residential, administrative and commercial regions. Only small industrial installation can be found in some areas of the city. The major industries and power generation plants are located outside the city in the Damascus Region.

3.2 Data base

The present emission inventory will show the contribution of the main emission sources in Damascus to the air pollution problem. The sources of consideration are: traffic, residential heating and commercial/industrial use of fuels.

Due to the lack of emission measurement data, all emissions were calculated using different calculation methods. Before the calculations could be done the data base and calculation procedures had to be defined. The calculation was based on information about the specific area, the fuel consumption, the content of pollutant in the fuel and on adequate emission factors.

The most recent year for which an almost complete set of data was available, was 1996. Therefore this year was selected as the year for the emission inventory.

Inventory Area and Sources

Damascus City covers an area of about 51 km^2. In 1997 1.5 million inhabitants were counted in this area. The city is divided by 11 regions, each of which is separated into 3 to 5 quarters. For the realisation of the inventory 3 representative regions with 6 quarters were selected:

- Region Saruja, selected quarters: Saruja, Ukaiba and Akssab,
- Region Al-Shagour, selected quarters: Bilal, Daumne/Karaune,
- Region Dummar, selected quarter: Mashro Dummar.

The region Saruja is situated in the centre of Damascus and is characterised by commercial and administrative activities and residential areas. Al-Shagour is a commercial and residential area which also has some small industry installations. Dummar, specifically Mashro Dummar is a pure modern residential area with low commercial activities. Figure 1 shows a map of Damascus and indicates the location of the selected areas.

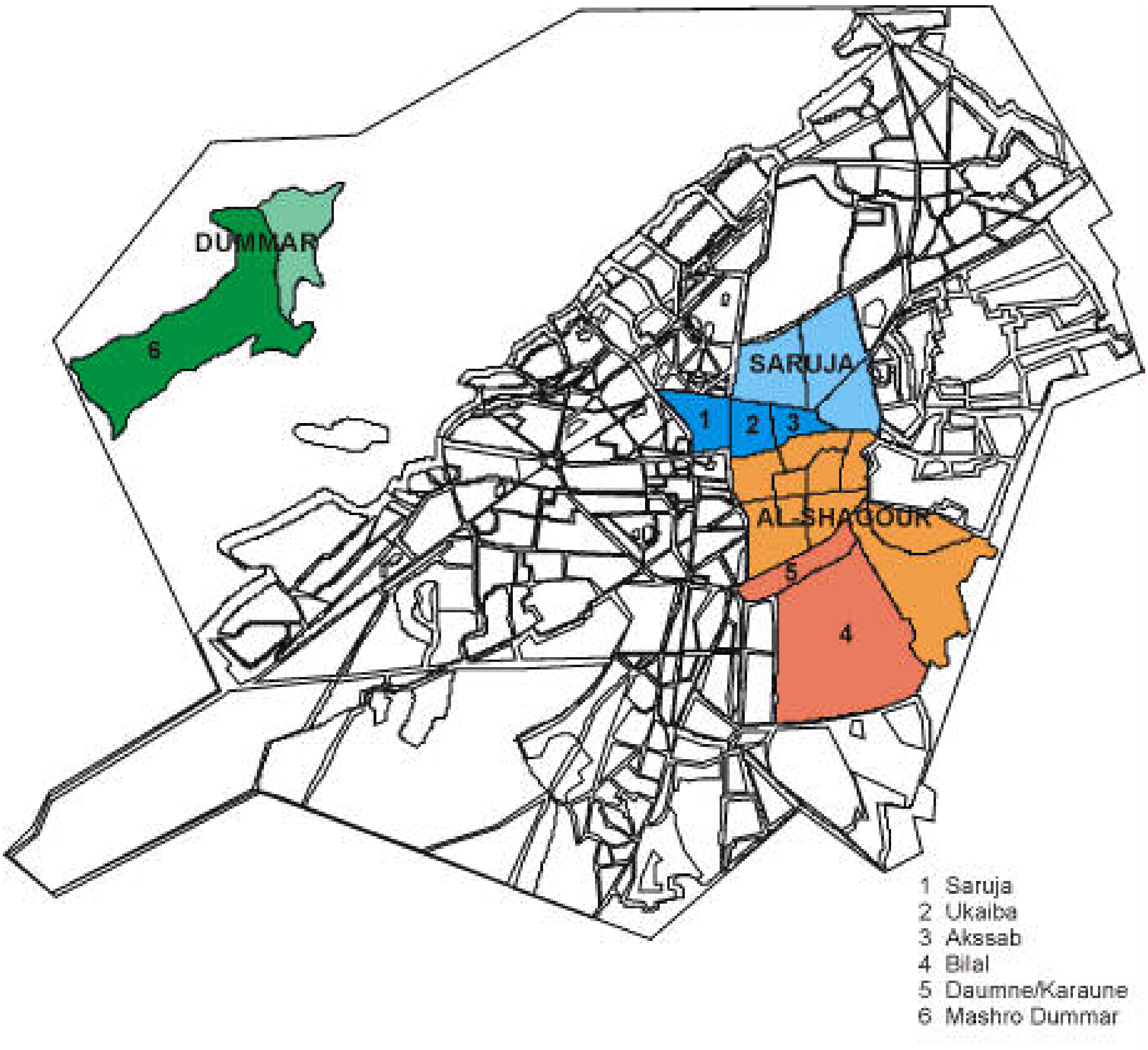


Figure 1: Map of Damascus and the selected regions and quarters.

The emission inventory covers the emission from residential heating and fuel use in commercial and industrial activities in the indicated areas. The necessary data for the calculations were compiled by the Environmental Department of the Governorate of Damascus. The surveyed data was the number of households and industries and their average annual fuel consumption. In table 3 the main characteristics of the selected regions and quarters are listed.

Table 3: Characteristics of the selected regions and areas in 1996 in the emission inventory (source [7]).

Region	Quarters	Area (ha)	Number of household	Number of industries
Saruja	Saruja	53.8	2083	402
	Ukaiba	30.2	1787	207
	Akssab	25.6	2574	141
AL –Shagour	Bilal	3.3	8443	251
	Daumne/Karaune	9.1	1156	257
Dummar	Mashro Dummar	139.3	6641	

Besides residential heating and commercial and industrial use of fuels, traffic is the most important source of airborne emission in Damascus. Due to the lack of geographically detailed data about the transport sector in specific regions or quarters of Damascus, this part of the emission inventory was realised for the whole area of Damascus City and Damascus Region. The region covers an area of about 18000 km^2 and has about 1.9 million inhabitants in 1997. The region consists of many small communities and largely of desert. In the communities all kinds of economic activities can be found, not only big industrial and energy generation plants.

The available data concerning road traffic are the number of vehicles, the type of fuel they use, and the total consumption of fuel as given in table 4.

Table 4: Number and type of vehicles in Damascus City and Damascus Region in 1996 (source [8]).

Vehicles	Number	Fuel type
Passenger Cars	73597	Gasoline
Busses	2102	Diesel
Mini Basses	9540	Diesel
Trucks	22621	Diesel
Pick-ups	36316	Gasoline
Motorcycles	18951	Gasoline
Others	4281	Gasoline

Until now detailed data about the mileage or average velocity of each vehicle or vehicle type is not available and therefore, the exact contribution of traffic cannot be calculated. In the present report a coarse estimation of the traffic emissions is integrated as first approach.

The inventory concentrates on the emissions caused by the use of fuel and examines the different sectors (traffic, residential and commercial/industrial). The fuels used in theses sectors are gasoline and diesel. In residences, diesel is used for heating using simple ovens without any emission control like the one shown in figure 2. This kind of room heating device is used throughout Damascus. It is only in Dummar, a modern pattern region, that the heating energy is generated in 6 central thermal stations, and provided to the households by tubes.

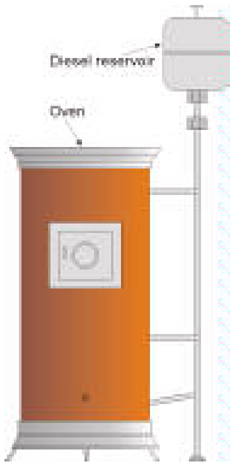


Figure 2: Simple oven used for residential heating.

Inventory Pollutants and Fuel

The emission inventory deals with sulphur dioxide (SO_2) carbon monoxide (CO). Table 5 gives the main characteristics of these pollutants related to the inventory.

Table 5: Characteristics of sulphur dioxide (SO_2) and carbon monoxide (CO).

Parameter	**SO_2**	**CO**
molecular weight (g/mol)	64	28
main sources	firings of sulphur containing fuels	firings
odour	pungent	none
boiling point (°C)	-10	-191,5
colour	none	none
toxic	yes	yes
aggregate	gas	gas

In table 6 the relevant characteristics of the fuels used are listed.

Table 6: Characteristics of gasoline and diesel fuel (source [9,10,11]).

Fuel	Density (kg/l)	Sulphur–content (%)
Diesel	0.84	0.7
Gasoline	0.72	0.15

There is no available data about the varying consumption of gasoline and diesel fuel of vehicles. Therefore the following assumptions were made:

- All the provided gasoline was consumed by gasoline vehicles.
- The provided diesel is consumed by vehicles and by the residential, energy and commercial/industrial sector. In order to identify the diesel consumption by vehicles a distribution of the consuming sectors as established in the 'Country Study on Climate Changes due to Greenhouse Gases' [12] was used. This is shown in table 7.

Table 7: Distribution of Diesel use in Syria (source [12]).

Transport sector	38.1 %
Energy sector	2.4 %
Residential sector	33.3 %
Industrial/commercial sector	26.2 %

This distribution means that for the estimation of the contribution of diesel vehicles to the SO_2 and CO emissions in Damascus, 38.1 % of the total provided diesel fuel of 1004797 t in 1996 was used. The total quantity of gasoline and diesel supplied to Damascus was given by the national petroleum company SADKOP [13].

Based on this data and considering the above mentioned distribution of diesel consumption, the following consumption data was used for the inventory as given in table 8.

Table 8: Gasoline and Diesel consumption by the transport sector in 1996 (source [12, 13]).

Fuel type	Annual consumption (t/a)	Number of consuming vehicles
Diesel	382828	34263
Gasoline	324924	133145

The consumption of fuel for residential heating and commercial/industrial use was surveyed by the ESRC and the Governorate. In the 6 selected quarters the number of households and commercial or industrial installations was surveyed. Besides the survey of these numbers the ESRC and the Governorate developed a questionnaire which was distributed in representative households and industries in order to identify the type and average consumption of fuel used. Based on these results the total consumption of fuel for each quarter was calculated. As a first result of this survey it can be stated that only diesel was used by the selected households and industries. The results of the survey and the calculated total consumption of diesel fuel in 1996 are listed in tables 9 and 10.

As mentioned above, the households the quarter 'Mashro Dummar' have no residential heating devices. Their heating energy is provided by 6 thermal stations. The data about the diesel consumption of these stations in 1996 was provided by the local operation organisation.

Table 9: Diesel consumption by the residential sector in 1996 (source [7]).

Region	Quarter	Number of households/stations	Diesel consumption per household/station (l/a)	Total annual consumption (t/a)
Saruja				
	Saruja	2083	550	962
	Ukaiba	1787	515	777
	Akssab	2574	732	1583
AL –Shagour				
	Bilal	8443	656	4652
	Daumne/Karaune	1156	813	790
Dummar				
	Mashro Dummar	6	1260000	6350

Table 10: Diesel consumption by commercial/industrial sector in 1996 (source [7]).

Region	Quarter	Number of commercial/industrial installations	Diesel consumption per installation (l/a)	Total annual consumption (t/a)
Saruja				
	Saruja	402	10172	3435
	Ukaiba	207	1500	261
	Akssab	141	9800	1161
AL –Shagour				
	Bilal	251	18500	3901
	Daumne/Karaune	257	24	5
Dummar				
	Mashro Dummar	0		

Emission Factors

Concerning carbon monoxide (CO), the emission estimate was based on calculations using emission factors. Emission factors are numbers which give the quantity of an emitted substance in relation to a certain quantity of used fuel, production or mileage. In the present case, emission factors for CO were used to estimate the CO emission in relation to the fuel (gasoline or diesel) used.

Considering that there are not yet specific Syrian emission factors, the most adequate international factors available were used.

For the residential heating of diesel fuel, the factors established by the German Federal Environmental Agency [14] for residential heating with uncontrolled ovens burning fuel oil (Heizöl EL) were used. The same factor was applied to estimate the CO emission of commercial firings, because in this sector the same kind of firing equipment was used. For the thermal plants in Moshra Dummar a different emission factor, which was established by the US Environmental Protection Agency (EPA) for internal combustion (SCC 20200104) [16], was used.

Considering the variety of emission factors for vehicles depending on the national emission control technologies applied in the different countries, the factors established by the IPCC [15] for general purposes were used. The IPCC listed its emission factors separated by fuel and vehicle type and by American and European vehicles. Because most of the vehicles in Syria are European or Japanese models, the factors for European vehicles were used.

In the IPCC workbook [15] four factors for passenger and light duty gasoline cars with uncontrolled emissions are listed (570 g/kg, 405 g/kg, 305 g/kg, 362 g/kg). The average of these values is 411 g CO per kg diesel burned. For motorcycles the workbook listed 3 emission factors (554 g/kg, 730 g/kg, 526 g/kg) with the average being 603 g/kg. Because there is no data available which allow a separate determination of the gasoline consumption of motorcycles and cars, it was necessary to define a unique CO emission factor for all gasoline consuming vehicles. Considering the vehicle distribution as given in table 4 (14,2 % of the gasoline vehicles were motorcycles, 85,8 % were cars) a weighted average emission factor (Ef) was determined using the following formula:

$$Ef = 0.142 * 603 \text{ g/kg} + 0.858 * 411 \text{ g/kg} = 438 \text{ g/kg}.$$

For European light and heavy duty vehicles with uncontrolled emission, the IPCC workbook [15] gives an emission factor of 17.4 g CO per kg diesel (light trucks) and 35.6 g CO per kg diesel (heavy trucks). In this case average emission factors also had to be applied. Therefore the following assumptions were considered:

- The minibusses (light duty vehicles) were running inside the complete reference region.
- The busses (heavy duty vehicles) were running inside the complete reference region.
- The heavy duty trucks were running only in small parts of the reference region.

Considering the vehicle distribution given in table 4 it was estimated that the light duty vehicles caused 90 % of the diesel related transport emissions and the heavy duty trucks caused 10 %. Using these percentages, the average emission factor was determined by using the following formula:

$$Ef = 0.1 * 35.6 + 0.9 * 17.4 = 19.2 \text{ g/kg.}$$

Table 11 gives an overview of the determined and applied emission factors for carbon monoxide.

Table 11: Emission factors for carbon monoxide (CO) used for the emission inventory (source [14,15,16]).

Sector		**g CO per kg fuel**
residential	diesel firing for heating	191
	thermal station burning diesel	130
commercial/industrial	diesel firing	191
transport	gasoline vehicles	438
	diesel vehicles	19,2

Calculation procedures

The emission of sulphur dioxide (SO_2) was calculated using the methodology of 'material balance'. In this case it is assumed that all of the sulphur contained in the fuel is converted into SO_2. Therefore the quantity of emitted SO_2 corresponds to the quantity of burned fuel multiplied with the sulphur content of the fuel and with the factor of the conversion of sulphur into sulphur dioxide, which is the quotient of the molecular weights. The resulting formula is:

$$E_{SO_2} = Q * P_S * \frac{M_{SO_2}}{M_S}$$

E_{SO2}: emission of SO_2 (t/a)
Q: quantity of burned fuel (t/a)
P_S: content of sulphur in fuel
M_{SO2}: molecular weight of SO_2 (g/mol)
M_S: molecular weight of S (g/mol)

The carbon monoxide emissions were determined by applying the emission factor calculations. In this case the quantity of fuel has to be multiplied with the emission factor corresponding to the used fuel:

$$E_{CO} = Q * Ef_{CO}$$

E_{CO}: emission of CO (t/a)
Q: quantity of burned fuel (t/a)
Ef_{CO}: emission factor of CO (kg/t)

The following results of the emission inventory were determined by the use of these formulas.

3.3 Results

Transport sector

The estimated annual emissions of carbon monoxide (CO) and sulphur dioxide (SO_2) in the reference region (Damascus City and Damascus Region) in the reference year (1996) are listed in table 12 and shown in figure 3.

Table 12: Estimated annual emissions of carbon monoxide (CO) and sulphur dioxide (SO_2) in Damascus City and Damascus Region in 1996.

Fuel	Emission (t/a)	
	SO_2	CO
Diesel	5359.6	7350.3
Gasoline	974.8	142317.0
Total	6334.4	149667.3

Due to diesel fuel having a 5 times higher sulphur content than gasoline, the main part of the SO_2 emission from the transport sector comes from the diesel vehicles. The total emission of SO_2 in Damascus City and Damascus Region in 1996 was approximately 6.3 kt.

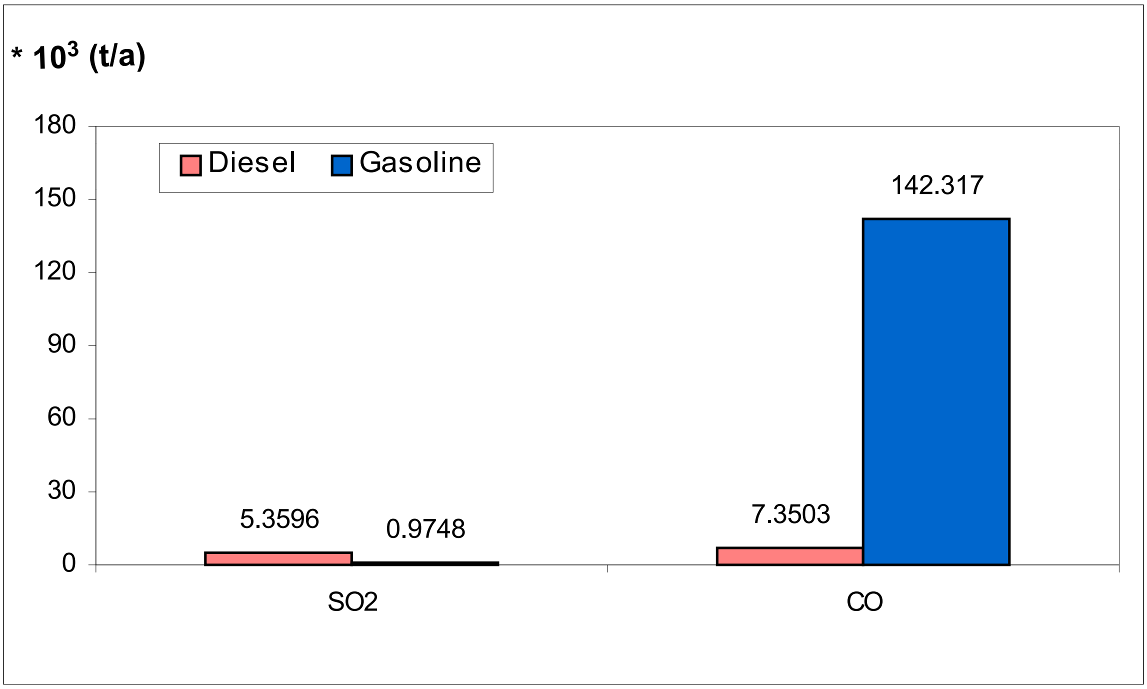


Figure 3: Estimated annual emissions (kt/a) of carbon monoxide (CO) and sulphur dioxide (SO_2) from vehicles in Damascus City and Damascus Region in 1996.

The uncompleted burning of gasoline causes a higher emission of CO in gasoline vehicles. The total emission of CO from the transport sector in Damascus City and Damascus Region was about 147.6 kt which was about 24 times higher than the SO_2 emission.

Residential sector

The total emission of SO_2 from residential heating in the 6 selected areas of Damascus was 211.6 t in 1996. The total quantity of CO emitted was 1789.9 t. The estimated emissions for each area are listed in table 13.

Table 13: Estimated annual emissions of carbon monoxide (CO) and sulphur dioxide (SO_2) by residential heating in Damascus City and Damascus Region in 1996.

Region	Quarter	Emission (t/a)	
		SO_2	CO
Saruja			
	Saruja	13.5	183.7
	Ukaiba	10.8	147.6
	Akssab	22.2	302.4
Al –Shagour			
	Bilal	65.1	888.5
	Daumne/Karaune	11.1	150.9
Dummar			
	Mashro Dummar	88.9	116.8
Total		211.6	1789.9

The highest emission of SO_2 from residential heating was found in Mashro Dummar where about 5422 households were supplied with heating energy by 6 thermal station. The second highest emission was calculated for the quarter of Bilal in the Al-Shagour region. This corresponds to the high number of households in this quarter and the relatively high consumption of fuel (table 8). The lowest emission values were determined for the quarters Ukaiba and Daumne/Karaune. In Ukaiba the households had the lowest average consumption of fuel and in Daumne/Karaune the lowest number of households were counted. For Saruja, the largest quarter, a low emission rate was also determined, due to the fact that this area is dominated by administrative and commercial activities. Figure 4 gives the comparison of SO_2 emission in the different quarters.

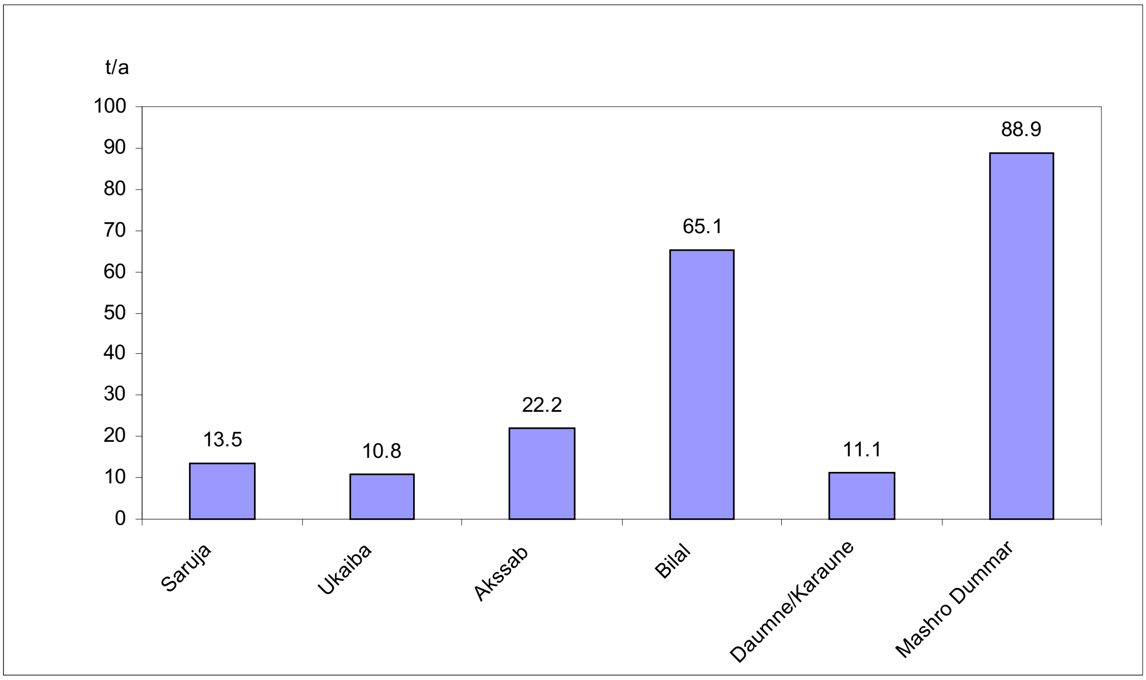


Figure 4: SO_2 emissions from residential heating in the 6 selected areas in Damascus in 1996.

Concerning CO, the highest emission rate was determined for Bilal due to the high number of households and their high consumption of fuel. The emission rates for the other quarters reflect the relation of the number of households and the average consumption of fuel. The lowest emission of CO was determined for Mashro Dummar. In this case, it was assumed that the central thermal stations had a better type of firing which resulted in a lower emission factor for CO. Figure 5 shows a comparison of the CO emission in the different areas.

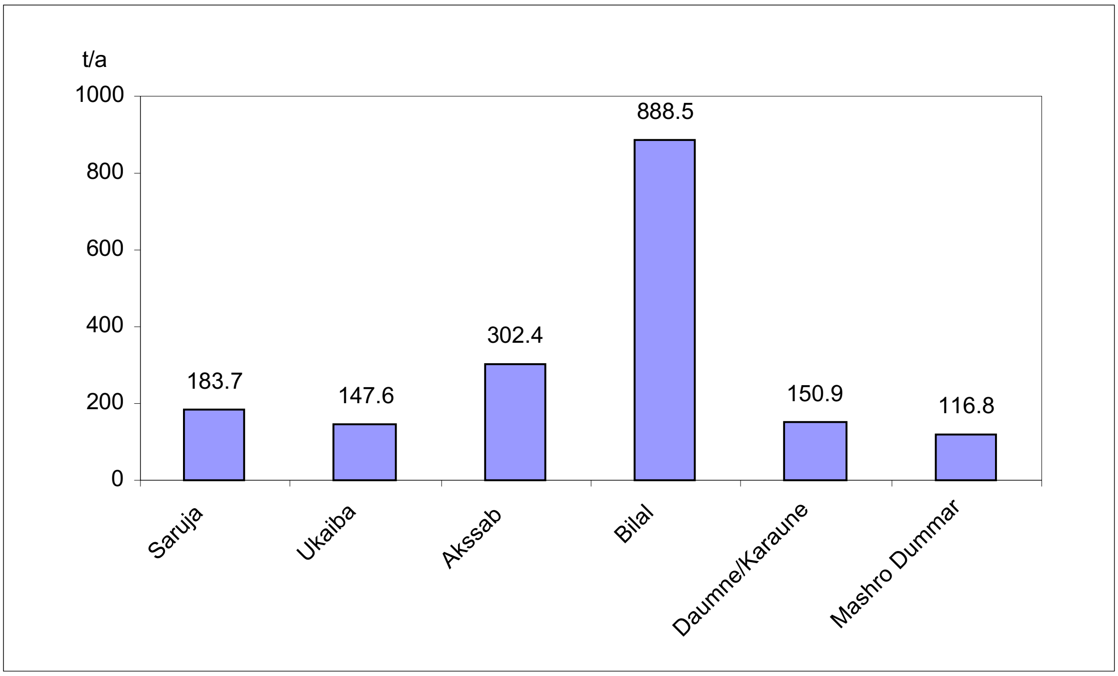


Figure 5: CO emissions from residential heating in the 6 selected areas in Damascus in 1996.

Commercial/industrial sector

In 1996 the total quantity of SO_2 emitted by firings from the commercial/industrial sector was 123.1 t and of CO 1673.9 t. Table 14 gives the emission rates for each area.

Table 14: Estimated annual emissions of carbon monoxide (CO) and sulphur dioxide (SO_2) from commercial and industrial firings in Damascus City and Damascus Region in 1996.

Region	Quarter	Emission (t/a)	
		SO_2	CO
Saruja	Saruja	48.1	656.1
	Ukaiba	3.7	49.9
	Akssab	16.6	221.8
Al –Shagour	Bilal	54.6	745.1
	Daumne/Karaune	0.1	1.0
Total		123.1	1673.9

The highest rates were determined for Bilal and Saruja because of the highest number of installations and the highest average consumption of diesel fuel in the areas.

In the quarter Mashro Dummar there was no commercial or industrial installation, therefore, no emission rate of this sector was determined for this area.

The lowest emission rate was determined for the quarter Daumne/Karaune although there was the second highest number of installations in this quarter. The majority of these installations were small shops and workshops which consumed only a very small amount of fuel. In figures 6 and 7 the annual SO_2 and CO emissions are given for each area.

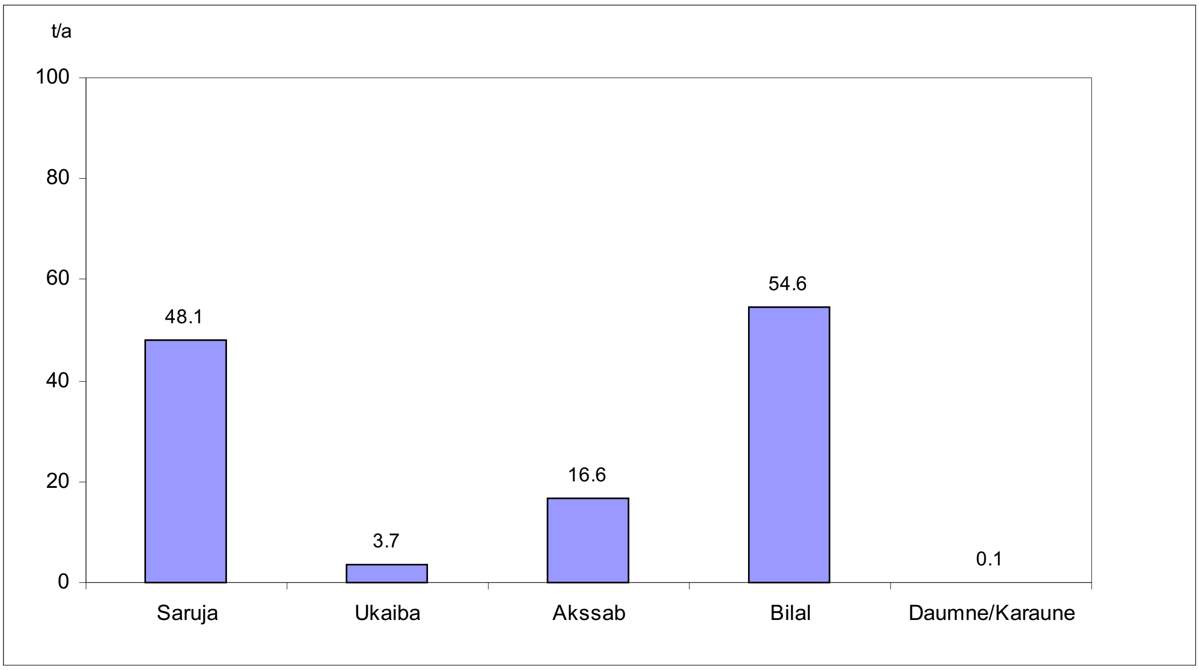


Figure 6: SO_2 emissions from commercial/industrial firings in the 6 selected areas in Damascus in 1996.

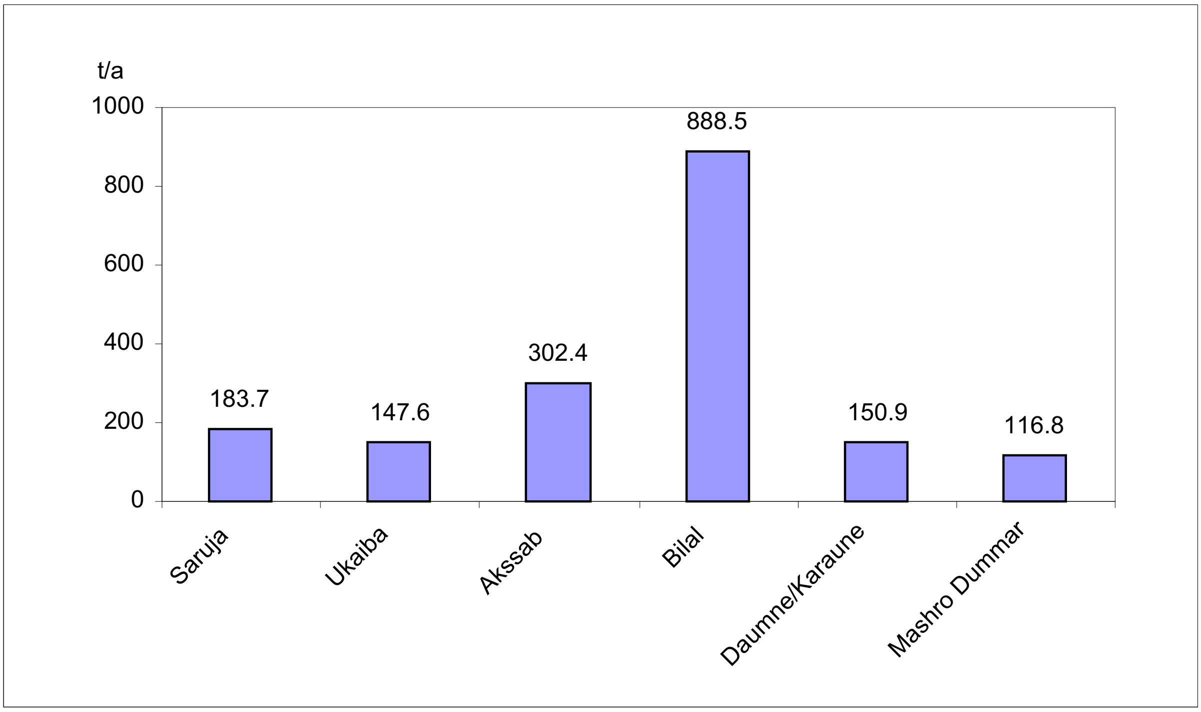


Figure 7: CO emissions from commercial/industrial firings in the 6 selected areas in Damascus in 1996.

The total emissions in the three regions Saruja, Al-Shagour and Dummar as given in figure 8 show comparable quantities for each region. The high number of households in Al-Shagour causes approximately the same quantity of emissions for SO_2 as well as for CO as the higher number of commercial and industrial installations in Saruja.

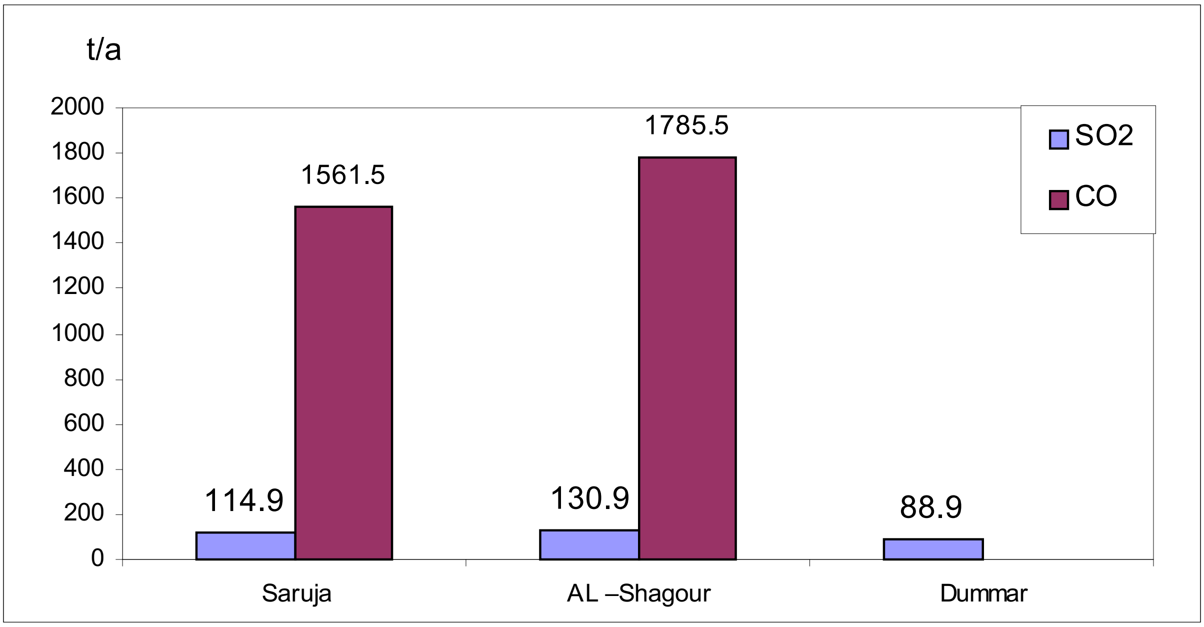


Figure 8: Total SO_2 and CO emissions in the quarters of the regions Saruja, Al-Shagour and Dummar in 1996.

Concerning the SO_2 emission, the rate of commercial/industry sector was 47 % higher than the rate of the residential sector in Saruja. In Al-Shagour the residential sector emitted 39 % more than the commercial/industrial sector. Figure 9 shows the total emission of SO_2 in the selected regions.

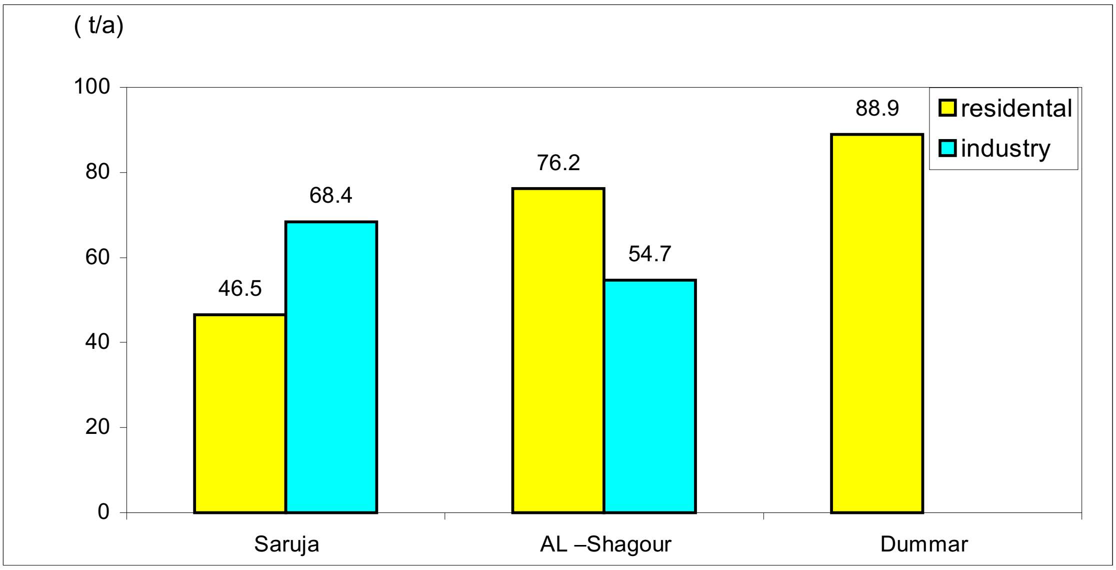


Figure 9: Total emission of SO_2 in the selected regions of Damascus in 1996.

Concerning CO, almost the same relations were determined for the different regions. In Saruja the emission was 46 % higher than that of the residential sector, in Al-Shagour the residential sector emitted 30 % more than the commercial/industrial sector. This is shown in figure 10.

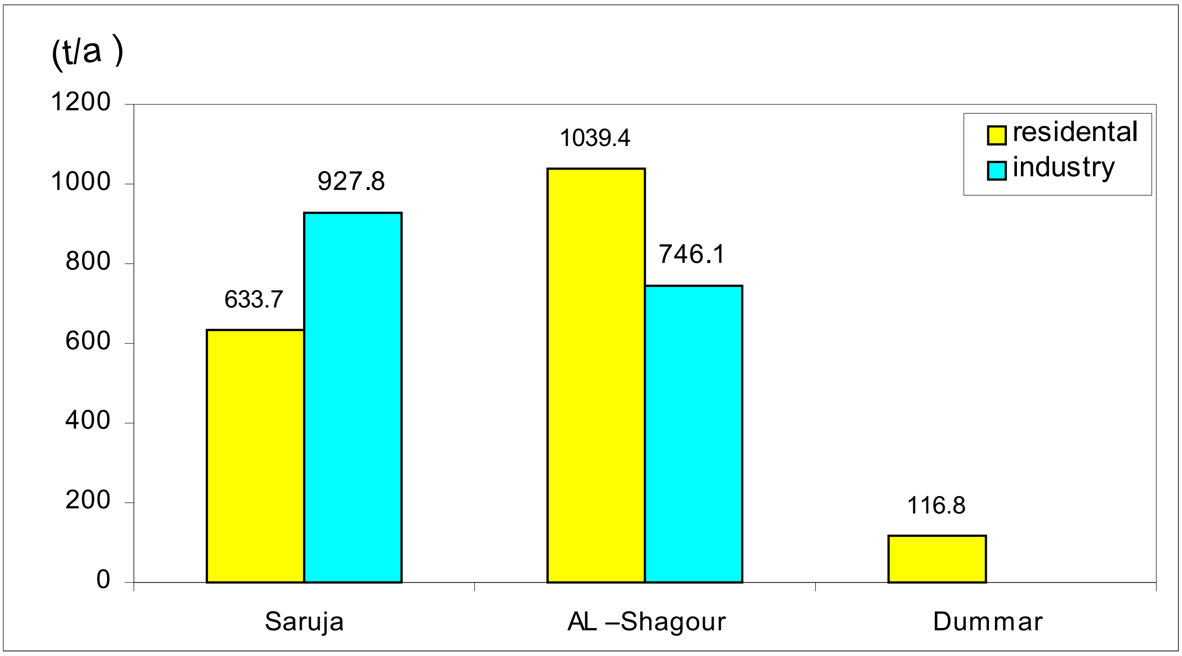


Figure 10: Total emission of CO in the selected regions of Damascus in 1996.

The results presented in the first crude emission inventory should be used as a hint of the main air pollution sources in Damascus. In order to establish a detailed and comprehensive air quality management programme, the emission inventory should be revised by considering more detailed data and the complete region of Damascus.

4 Air quality monitoring

4.1 Introduction

The central objective of the technical co-operation project was a study of air quality in Damascus in order to prepare a consistent air quality monitoring programme for the future. Therefore, a pilot monitoring programme was designed and realised in 1999 and 2000.

The programme was executed by using advanced technologies of monitoring. Sophisticated equipment was adjusted to local conditions and used for measuring pollutant concentrations. The main part of the monitoring was done by using state-of-the-art automatic analysers which were mounted in a container on a truck (Mobile Unit). This way, it was easily possible to relocate the monitoring equipment to various sites throughout Damascus. In some locations where it was not possible to set up the Mobile Unit, electronic controlled gas sampling systems were installed. In these cases the sampled pollutants were analysed later in the laboratory of the ESRC.

In order to get sufficient information about the air quality in Damascus, 15 monitoring sites were selected. These sites represented the different types of areas in Damascus.

In the following chapters the monitoring (pollutants, periods, frequency, sites) will be described, as well as the results obtained.

4.2 Monitoring strategy

4.2.1 Pollutants

For the pilot monitoring programme 5 air pollutants were selected to be monitored:

- total suspended particulates (TSP)
- sulphur dioxide (SO_2)
- nitrogen monoxide (NO)
- nitrogen dioxide (NO_2) and
- carbon monoxide (CO).

The concentrations of TSP, SO_2 and NO_2 were measured at each one of the monitoring sites; the concentrations of NO and CO only at the sites where it was possible to inbstall the Mobile Unit.

Besides the analysers for concentration measurements, the Mobile Unit is equipped with monitors for wind direction and wind velocity.

4.2.2 Monitoring methods

Total Suspended Particulates (TSP)

The concentration of particles in air were measured by ‘gravimetric’ methods. A defined volume of ambient air is sucked through a filter which retains the particles. Before the sampling the unloaded filter is weighted. After the sampling the loaded filter is weighted again and the difference is the weight of the sampled particles. The concentration of TSP is obtained by dividing of the determined weight of particles by the total volume of air sucked through the filter.

A high-volume-sampler (HVS) was used for the monitoring. Figure 11 shows a schematic diagram of such a HVS.

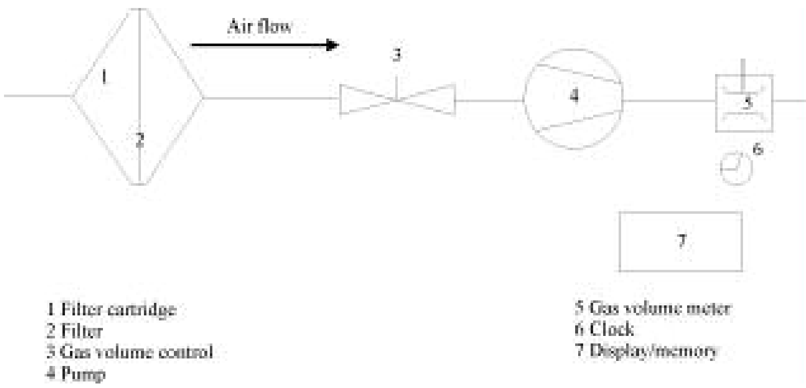


Figure 11: Schematic diagram of a High-Volume-Sampler (HVS) as used for the pilot monitoring in Damascus.

During the sampling the HVS registers the flow of air, the period of sampling and the total volume of sampled air. The filter part of the HVS used in Damascus is shown in figure 12.

Figure 12: The High-Volume-Sampler (HVS) as used for the pilot monitoring in Damascus.

Sulphur Dioxide (SO_2)

The concentration of SO_2 was measured in two ways: manual and automatic.

The manual method consists of air sampling followed by laboratory analysis. An electronic controlled air sampling device was used to retain the SO_2 from ambient air; figure 13 shows a schematic diagram of this equipment.

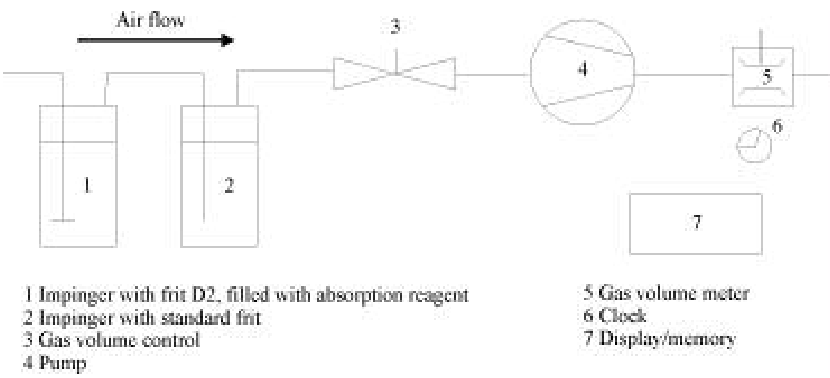


Figure 13: Schematic diagram of a gas sampling device as used for the pilot monitoring in Damascus.

Ambient air is sucked by a pump through an impinger which is filled with an absorbing reagent. This reagent absorbs separates the SO_2 molecules form air. After the defined sampling time, the SO_2 content of the solution is analysed in the laboratory using the TCM-method (Tetrachloromercurate-method). In the analysis the SO_2 molecules react with the other chemicals and form a coloured complex. The intensity of the colour corresponds to the quantity of SO_2 in the solution.

The automatic measurement of SO_2 concentration was done using an UV-fluorescence analyser. The measuring principle is based on the excitation of SO_2 molecules by UV radiation and the following fluorescence of SO_2. The ambient air is sucked through a measuring chamber where UV radiation is emitted. The SO_2 reacts with fluorescence and the intensity of this fluorescence corresponds to the concentration of SO_2 in air.

The automatic SO_2 analyser allows a continuous measurement of the concentration. The equipment is mounted together with the other automatic equipment in a Mobile Unit (figure 14).

Figure 14: Mobile Unit for air quality monitoring in Damascus.

Nitrogen Monoxide/Dioxide (NO/NO_2)

The concentration of NO_2 was measured in two ways: manual and automatic

The manual method consists of air sampling followed by laboratory analysis. An electronic controlled air sampling device was used to retain the NO_2 from ambient air; figure 13 shows a schematic diagram of this equipment.

Ambient air is sucked by a pump through an impinger which is filled with an absorbing reagent. This reagent absorbs separates the NO_2 molecules from the air. After the defined sampling time, the NO_2 content of the solution is analysed in the laboratory using the Saltzman-method. The NO_2 molecules react with the absorbing reagent to form a coloured complex. The intensity of the colour corresponds to the quantity of NO_2 in the solution.

The automatic measurement of NO_2 concentration was done using an chemiluminescence analyser. The measuring principle is based on the reaction of NO with ozone under the emission of fluorescence radiation. Inside the analyser the NO_2 is reduced to NO which reacts with the internally generated ozone. Therefore, the ambient air is sucked through a reduction chamber and a radiation chamber. A part of the air does not pass through the reduction chamber, but only the radiation chamber. In this case the NO content of the ambient air can be measured.

The automatic NO_2/NO analyser allows a continuous measurement of the concentrations. The equipment is mounted together with the other automatic equipment in a Mobile Unit (figure 15).

Figure 15: Automatic analysers and the control computer in the Mobile Unit.

Carbon Monoxide (CO)

The concentration of CO was measured with an automatic IR-absorption analyser. The measurement uses the capacity of CO molecules to absorb IR radiation. The ambient air is sucked through a measuring chamber where IR radiation is emitted. The CO absorbs a part of the radiation and the reduction of radiation intensity corresponds to the concentration of CO in air.

4.2.3 Monitoring Sites

For the pilot monitoring in Damascus 15 monitoring sites were chosen. These sites are representative of the different regions of Damascus, suffering different impacts of air pollution. A brief description of the sites and their location is given in table 15. Figure 16 shows the location of the sites in the city of Damascus.

The sites MHZ, BAM and BT2 were selected as representative for areas with a high traffic influence, which suffer predominantly from high vehicle emissions. In these sites the monitoring equipment was installed at the side of the streets in order to measure the pollutant concentration at the street side.

The other sites were selected to monitor air pollution in different quarters without a direct influence of any specific emission source. Therefore, the measuring equipment was installed in lateral roads or courtyards.

At each site the equipment was installed in open places with a free flow of air. Criteria were that within a circle of at least 5 m there were no trees, walls or similar obstructions which could interfere with the air sampling.

The total suspended particulates were sampled at 1.5 m above ground level. The sample inlet of the air sampling device for the laboratory analysis of the SO_2 and NO_2 concentrations was mounted between 1 and 5 m above the ground. The sample inlet of the Mobile Unit was fixed on top of the container at 3,5 m above ground level. The wind sensor of the Mobile Unit was installed on a telescope mast. During the monitoring the mast was elevated to 7 m above ground level to measure the wind velocity and wind direction.

Table 15: Location and brief description of monitoring sites.

Name	Abreviation	Location	Description
MOUHAFAZA	MHZ	Youssef Al Azmeh Square, entrance of Youssef Al Azmeh Street, next to the existing monitoring station.	Innercity site, high movement of people and vehicles during the day.
BARAMIKEK	BAM	South entrance of the bus station; Baramikeh Place	Residential area with high traffic.
TIJARA	TIJ	Place between Az Zubeir Street and Jaber Ibn Hayyan Street.	Residential area.
MIDAN	MID	Al Haklah Street, between Al Tauhedi School and cemetery.	Southern residential area.
DUMMAR	DUM	Place in front of the Post Office.	Residential area in north-west, reference.
DWELLA1	DW1	At the Dwella Hospital, on the entrance roof.	Residential area with high traffic load in southwest (downwind of the city in relation to the main wind direction); unpaved roads.
DWELLA2	DW2	Jramana, Al-Younisia, Ibrahim Al-Khalil Convent.	Residential area; unpaved roads.
BAB TUMA1	BT1	Maktab Ambar office. At the top of the entrance building.	Residential area in the old city.
BAB TUMA2	BT2	Bab Tuma Square.	Next to a residential area of the old city with high traffic impact.
JOBAR1	JO1	At the top of the entrance building of the Al Djihad School.	Eastern residential area; unpaved roads
JOBAR2	JO2	Tiba	Eastern residential area; unpaved roads.
MUHAJRIN1	MJ1	At the top of the Salahaddin Al-Ayoubi School.	Nothern residential area, above the city level; unpaved roads.
MUHAJRIN2	MJ2	Cemetary.	Nothern residential area, above the city level.
MUHAJRIN3	MJ3	Khorshid Square	Nothern residential area, above the city level.
BAB SHARKI	BSH	Al Zaiton Square.	Inside a residential area of the old city. No traffic impact.

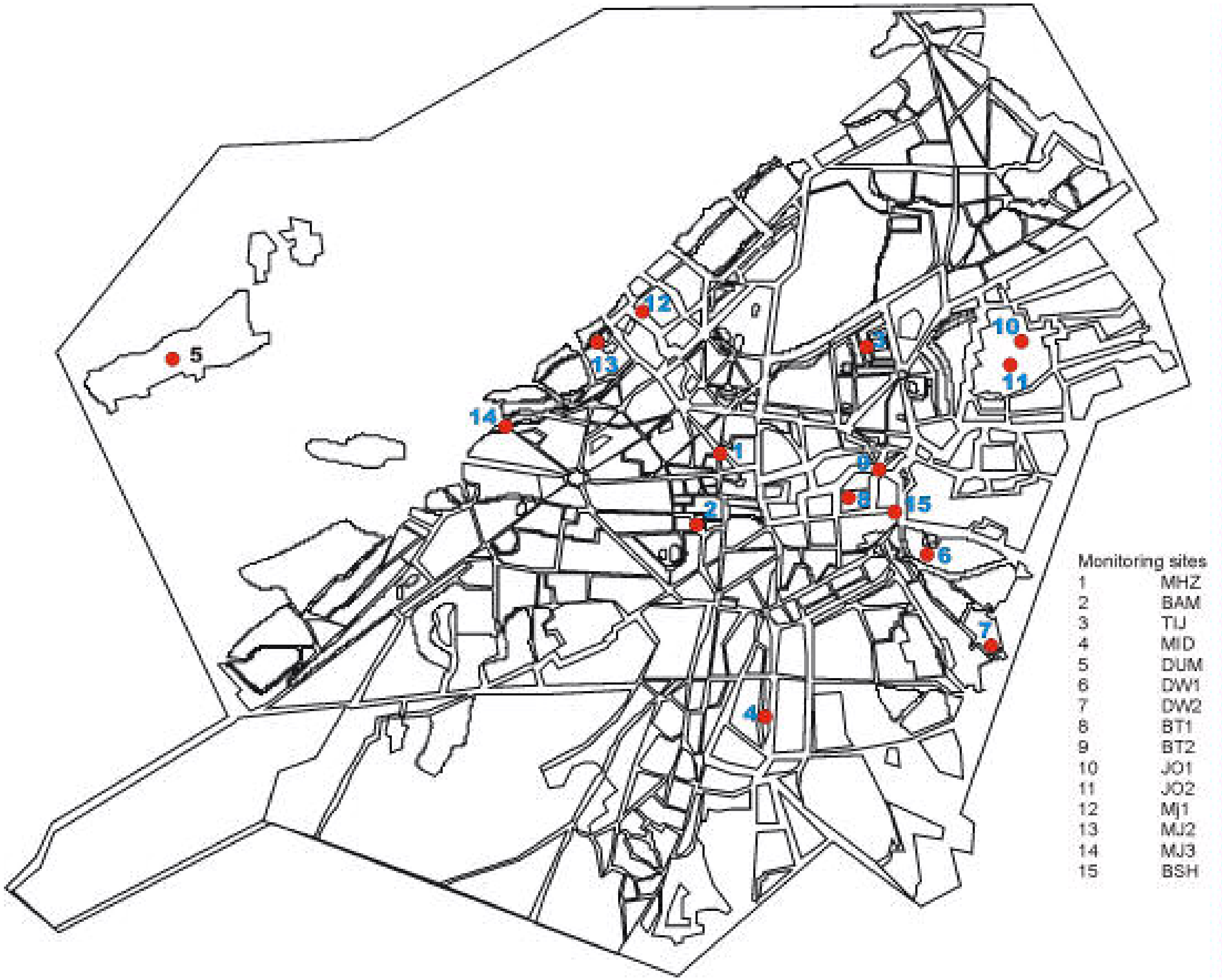


Figure 16: 15 air quality monitoring sites in Damascus.

4.2.4 Monitoring Periods and Frequencies

The pilot air quality monitoring in Damascus was executed form October 1999 to November 2000.

The monitoring periods at each monitoring site varied between 5 and 15 days; at most of the sites the monitoring covered a period of 7 days. At every site at least two periods were monitored in order to cover different times of the year.

The automatic equipment in the Mobile Unit was running continuously during the monitoring period at each site. The analysers saved a concentration value every two seconds in an internal temporary memory file. After 30 minutes the analyser calculated a 30-minute-average concentration value which was transmitted to the control computer inside the Mobile Unit. This computer stored the 30-minute-average values for further processing and evaluation.

The air sampling devices for the monitoring of TSP, SO_2 and NO_2 ran for 24 hours every second day. This way the manual methods provided 24-hours average concentration values for three days a week.

In table 16 the monitoring periods and pollutants at each monitoring site are listed.

Table 16: Monitoring periods and monitored pollutants at the 15 monitoring sites.

Monitoring site	Monitoring period	Pollutants
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	TSP
	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	SO_2, NO_2, NO, CO automatic
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 18.08.00	TSP
	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 20.08.00	SO_2, NO_2, NO, CO automatic
TIJ	18.06.00 – 31.06.00; 05.08.00 – 09.08.00	TSP
	18.06.00 – 23.06.00; 27.07.00 – 12.08.00	SO_2, NO_2, NO, CO automatic
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00	TSP
	09.06.00 – 16.06.00; 19.07.00 – 25.07.00	SO_2, NO_2, NO, CO automatic
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	TSP
	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	SO_2, NO_2, NO, CO automatic
DW1	01.11.99 – 15.11.99	SO_2, NO_2 manual
	04.11.99 – 15.11.99	TSP
DW2	28.09.00 – 04.10.00	TSP
	28.09.00 – 04.10.00	SO_2, NO_2, NO, CO automatic
BT1	05.10.99 – 18.10.99	SO_2, NO_2 manual
	10.10.99 – 18.10.99	TSP
BT2	03.11.00 – 12.11.00	TSP
	02.11.00 – 12.11.00	SO_2, NO_2, NO, CO automatic
JO1	19.10.99 – 31.10.99	SO_2, NO_2 manual
	19.10.99 – 29.10.99	TSP
JO2	20.09.00 – 26.09.00	TSP
	20.09.00 – 26.09.00	SO_2, NO_2, NO, CO automatic
MJ1	16.11.99 – 29.11.99	SO_2, NO_2 manual
	17.11.99 – 23.11.99	TSP
MJ2	06.10.00 – 12.10.00	TSP
	06.10.00 – 13.10.00	SO_2, NO_2, NO, CO automatic
MJ3	24.10.00 – 30.10.00	TSP
	26.10.00 – 31.10.00	SO_2, NO_2, NO, CO automatic
BSH	11.09.00 – 17.09.00	TSP
	11.09.00 – 18.09.00	SO_2, NO_2, NO, CO automatic

4.3 Registration and handling of monitoring data

In the Mobile Unit the 30-minute-average concentrations provided by the analysers were saved in a data-base file in the control computer inside the Unit. The transmission, registration and saving software was provided by the manufacturer of the Mobile Unit. The data-base file was regularly copied on a disk. Another copy of the file was installed in the ESRC's high-technology computer for further evaluation and processing of the data.

The usual statistical evaluation was done using the evaluation software which was part of the software package of the Mobile Unit. The more sophisticated calculations and visualisations were realised with standard calculation and visualisation software programmes.

After a verification and validation of the 30-minute-values obtained the following parameters were calculated:

- 1 hour average concentrations
- 24 hour average concentrations
- minimum and maximum of the 1 hour average concentrations
- 98 percentile of the 30 minutes average concentrations
- average concentration for each monitoring period and site
- average concentration for each monitoring site
- diurnal variations
- wind roses
- concentration roses.

The manual samples were accompanied by sample sheets where all relevant data concerning the sample (date, time, volume of sampled air, concentration etc.) was registered. This registered data was digitised into an data-base file on the ESRC's evaluation computer. The following statistical calculations were done using standard calculation software programmes:

- average concentration for each monitoring period and site
- average concentration for each monitoring site.

4.4 Results

4.4.1 Overview

During the pilot monitoring programme in Damascus between October 1999 and November 2000, different types of concentration values – 30-minute-values and 24 hour values – were registered.

A total number of 39208 valid concentration values and meteorological data was obtained. This data was used for further processing and evaluation. The following numbers were registered:

- 74 24-h average concentration values of TSP
- 18 24-h average concentration values of SO_2
- 16 24-h average concentration values of NO_2
- 6204 30-min average concentration values of SO_2
- 6540 30-min average concentration values of NO_2
- 6540 30-min average concentration values of NO
- 6632 30-min average concentration values of CO
- 6632 30-min average concentration values of wind direction
- 6632 30-min average concentration values of wind velocity.

4.4.2 Total suspended particulates

At most of the monitoring sites the average concentration of TSP was in the range between 200 $\mu g/m^3$ and 300 $\mu g/m^3$. The highest average concentration (369 $\mu g/m^3$) was observed at the monitoring site BT2 at the Bab Tuma Square. At the same site the highest 24-h value was also measured. The lowest average concentration (86 $\mu g/m^3$) was obtained at the monitoring site MJ3 at the Khorshid Square in Muhajrin. The lowest 24-h concentration value was also measured at the MJ3 site. All the average concentrations of TSP as well as the lowest (minimum) and highest (maximum) 24-h concentration values are listed in table 17.

The results obtained from the monitoring site JO2 were omitted because dust and soil were put into the sample inlet on each sampling day.

Table 17: Average concentrations of TSP for the complete manual monitoring period at each monitoring site, based on the registered 24-h concentration values.

Site	**Period**	**Average concentration (µg/m³)**	**Minimum of the 24-h average concentrations (µg/m³)**	**Maximum of the 24-h average concentrations (µg/m³)**
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	259	168	379
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 18.08.00	223	168	273
TIJ	18.06.00 – 31.06.00; 05.08.00 – 09.08.00	229	190	330
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00	231	216	290
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	237	137	453
DW1	04.11.99 – 15.11.99	330	212	466
DW2	28.09.00 – 04.10.00	285	126	486
BT1	10.10.99 – 18.10.99	192	129	259
BT2	03.11.00 – 12.11.00	369	173	522
JO1	19.10.99 – 29.10.99	272	215	382
JO2	20.09.00 – 26.09.00	-	-	-
MJ1	17.11.99 – 23.11.99	253	174	440
MJ2	06.10.00 – 12.10.00	287	202	371
MJ3	24.10.00 – 30.10.00	86	71	136
BSH	11.09.00 – 17.09.00	187	98	292

As demonstrated in figure 17, the variation of the measured 24-h concentration covers a range from 71 µg/m³ to 522 µg/m³. The highest variation values were observed at the monitoring sites DUM, DW1, DW2 and BT2. The smallest variation was found at MID and MJ3.

In order to obtain an average concentration value for the complete monitored area, the average of the average concentrations at every monitoring site was calculated. This calculation gives an average TSP concentration for Damascus of 246 µg/m³.

Figure 18 shows the highest concentrations in the eastern and northern part of Damascus and at the monitoring site (MHZ) in the centre.

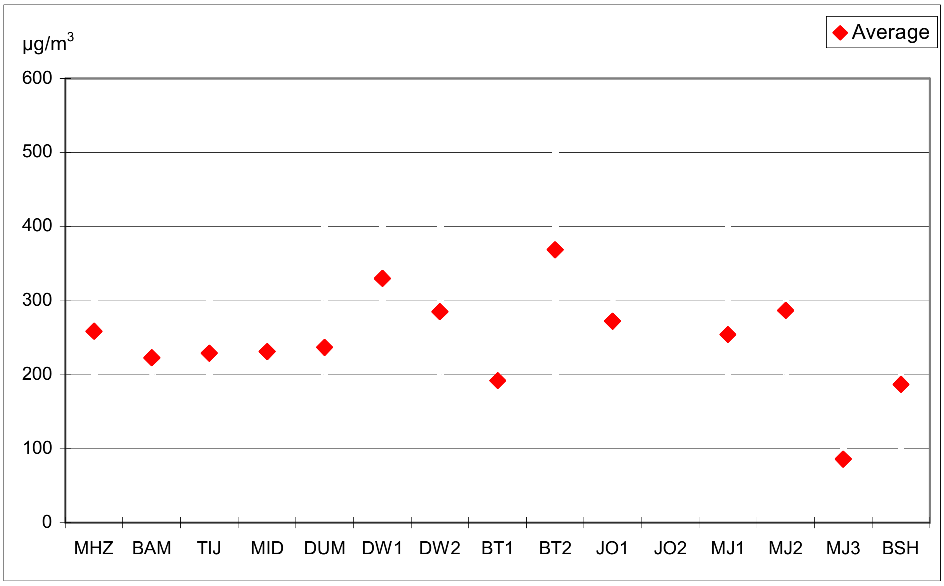


Figure 17: Average concentrations of TSP and range of 24-h concentrations at the monitoring sites in Damascus

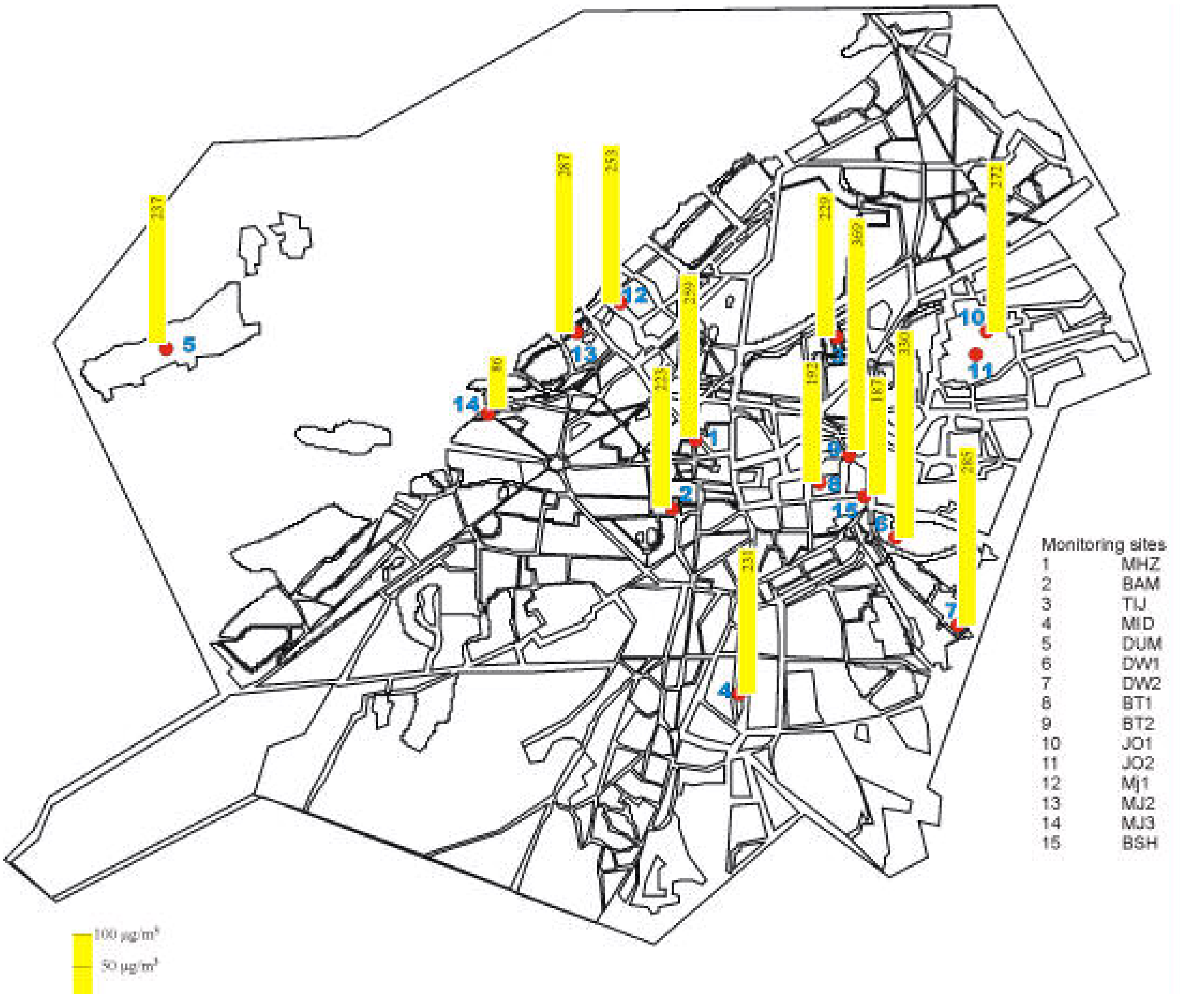


Figure 18: Average TSP concentrations (µg/m^3) at the monitoring sites in Damascus 1999/2000.

4.4.3 Sulphur dioxide

The average concentration of SO_2 at most of the monitoring sites lay between 10 µg/m^3 and 50 µg/m^3. The highest averages were obtained at the monitoring sites BT2 at the Bab Tuma square and MJ2 and MJ3 in Muhajrin. These high concentrations were observed during the monitoring period in October and November 2000. The lowest average concentration of SO_2 was measured at the monitoring site DUM in Dummar.

In order to get an average concentration value for the complete monitored area, the average of the average concentrations at each monitoring site was calculated. This calculation gives an average SO_2 concentration for Damascus of 39 µg/m^3.

The average concentrations of the first measurements using the manual methods are listed in table 18. Table 19 gives the average concentrations of the continuous monitoring with the Mobile Unit. In the same table the highest and the lowest 1-h averages as well as the 98 percentile of the registered 30-minute-average concentrations are listed.

As it can be seen from table 19, the range of the obtained 1-h averages varied from below the detection limits of the analysers (1 µg/m^3) as high as 396 µg/m^3. The highest 1-h average concentration was determined at the monitoring site BT2 (396 µg/m^3). The maximum concentrations of the other monitoring sites varied between 120 µg/m^3 and 240 µg/m^3. Only in the monitoring sites DUM and MID, even the maximum concentrations were below 100 µg/m^3.

Table 18: Average concentrations of SO_2 for the complete manual monitoring period at each monitoring site, based on the registered 24-h concentration values.

Site	**Period**	**Average concentration (µg/m^3)**
BT1	05.10.99 – 17.10.99	15
JO1	19.10.99 – 30.10.99	22
DW1	01.11.99 – 15.11.99	25
MJ1	18.11.99 - 29.11.99	38

Sometimes the maximum concentration value at a monitoring site does not show that the overall short-term level of pollution is high, but only reflects one unique event. In order to avoid the consideration of such single occurrences, the 98 percentile of the measured 30 minutes average concentrations is determined.

A 98 percentile is a concentration value where 98 % of the measured concentrations are below this value and only 2 % are higher. As it can be seen in table 19, the 98 percentile is always less than or equal to the maximum value. In the case of the present pilot monitoring, each period covered about 7 days and about 300 concentration values were obtained, that means about 6 values were high than the indicated 98 percentile.

Table 19: Average concentrations of SO_2 for the continuous monitoring periods at each monitoring site, based on the 1-h concentration values, minimum and maximum 1-h averages and 98 percentiles[1] of the registered 30-min values

Site	Period	Average concentration (µg/m³)	Minimum of the 1-h average concentrations (µg/m³)[2]	Maximum of the 1-h average concentrations (µg/m³)	98 percentile of 30-min concentration values (µg/m³)
MHZ	16.05.00 – 22.05.00;	37	1	172	103
	25.06.00 – 01.07.00	39	< 1	203	123
	total	37	< 1	203	
BAM	24.05.00 – 30.05.00;	44	8	130	110
	03.07.00 – 09.07.00;	38	< 1	231	164
	14.08.00 – 20.08.00	52	5	193	150
	total	45	< 1	231	
TIJ	17.06.00 – 23.06.00;	27	6	123	82
	27.07.00 – 12.08.00	45	< 1	199	169
	total	36	6	199	
MID	09.06.00 – 15.06.00;	13	< 1	54	70
	19.07.00 – 25.07.00	23	2	101	85
	total	18	< 1	101	
DUM	01.06.00 – 07.06.00;	10	< 1	235	41
	11.07.00 – 17.07.00	7	< 1	52	39
	total	8	< 1	235	
DW2	28.09.00 – 04.10.00	26	< 1	148	97
BT2	02.11.00 – 12.11.00	123	34	396	306
JO2	20.09.00 – 26.09.00	40	5	138	133
MJ2	06.10.00 – 14.10.00	61	2	236	164
MJ3	26.10.00 – 31.10.00	61	10	229	207
BSH	11.09.00 – 18.09.00	35	4	151	106

[1]: 98 % of the concentration values were below this concentration.
[2]: in case of values below the detection limit of the analyser (1µg/m³), '< 1' was indicated.

At the monitoring sites BT2 and MHZ, for example, there is a significant difference between the maximum and the 98 percentile value. This indicates that only a few values are very high in comparison to the majority of values.

The highest 98 percentiles were determined at those monitoring sites which suffered influences from traffic (MHZ, BAM) and during the monitoring in October and November (MJ3, BT2).

Figure 19 demonstrates the average SO_2 concentrations at the 15 monitoring sites in Damascus in 1999 and 2000. At the monitoring sites with no direct influences of certain emission sources (p. ex.: MID, JO1, JO2, DW2, DUM) the concentrations were low. In areas with high traffic impact or high population density the value were higher.

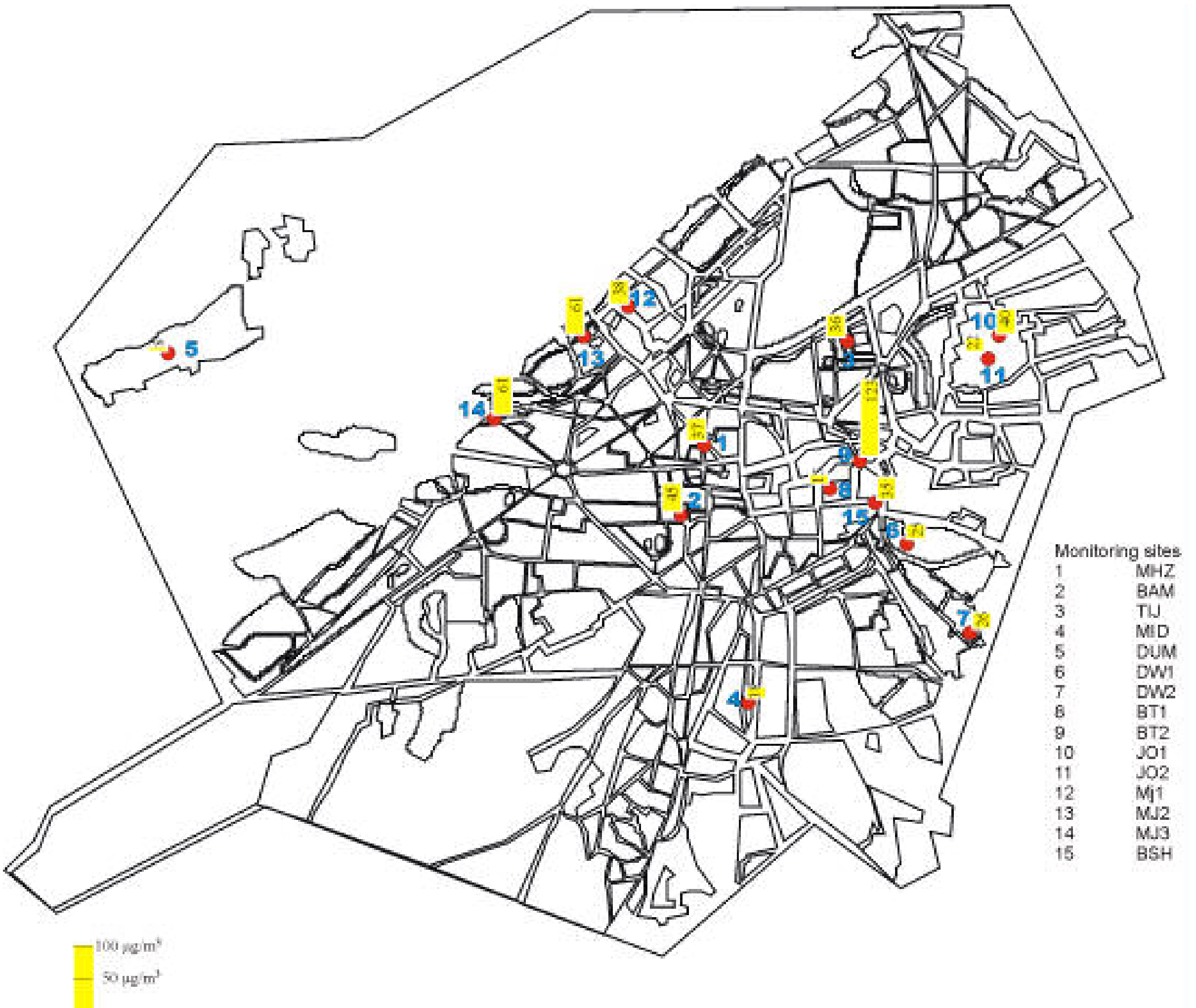


Figure 19: Average SO_2 concentrations ($\mu g/m^3$) at the monitoring sites in Damascus 1999/2000.

Besides the long-term and 1-h standards (table 2) the 24-h values are used to evaluate the quality of air. Therefore, at every monitoring site the 24-h concentrations of SO_2 for each monitoring day (00:00 – 24:00) were calculated. The mean, maximum and minimum of these 24-h averages are listed in table 20.

Table 20: Mean, maximum and minimum of 24 –h average concentrations of SO_2 for the continuous monitoring periods at each monitoring site.

Site	**Period**	**Average 24-h concentration (µg/m³)**	**Minimum of the 24-h concentrations (µg/m³)**	**Maximum of the 24-hconcentrations (µg/m³)**
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00 total	35 38 36	13 31 13	53 60 60
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 20.08.00 total	43 42 57 48	22 33 44 22	56 60 82 82
TIJ	17.06.00 – 23.06.00; 27.07.00 – 12.08.00 total	31 44 45	29 17 17	31 111 111
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00 total	15 21 19	9 14 9	20 28 28
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00 total	14 9 10	2 2 2	32 39 39
DW2	28.09.00 – 04.10.00	27	9	46
BT2	02.11.00 – 12.11.00	124	93	151
JO2	20.09.00 – 26.09.00	42	24	57
MJ2	06.10.00 – 14.10.00	58	28	81
MJ3	26.10.00 – 31.10.00	62	51	76
BSH	11.09.00 – 18.09.00	32	13	57

Like in the case of the overall average SO_2 concentrations, the highest 24-h values were obtained at the monitoring site BT2, MJ2 and MJ2. At the monitoring sites BT2 and MJ3 the range of the 24-h concentration is relatively small, as it is demonstrated in figure 20. That means that the 24-h concentration differs only slightly.

As figure 20 clearly shows, the 24-h values at the monitoring site BT2 were out of the range of the other sites, which were between 10 and 60 µg/m^3.

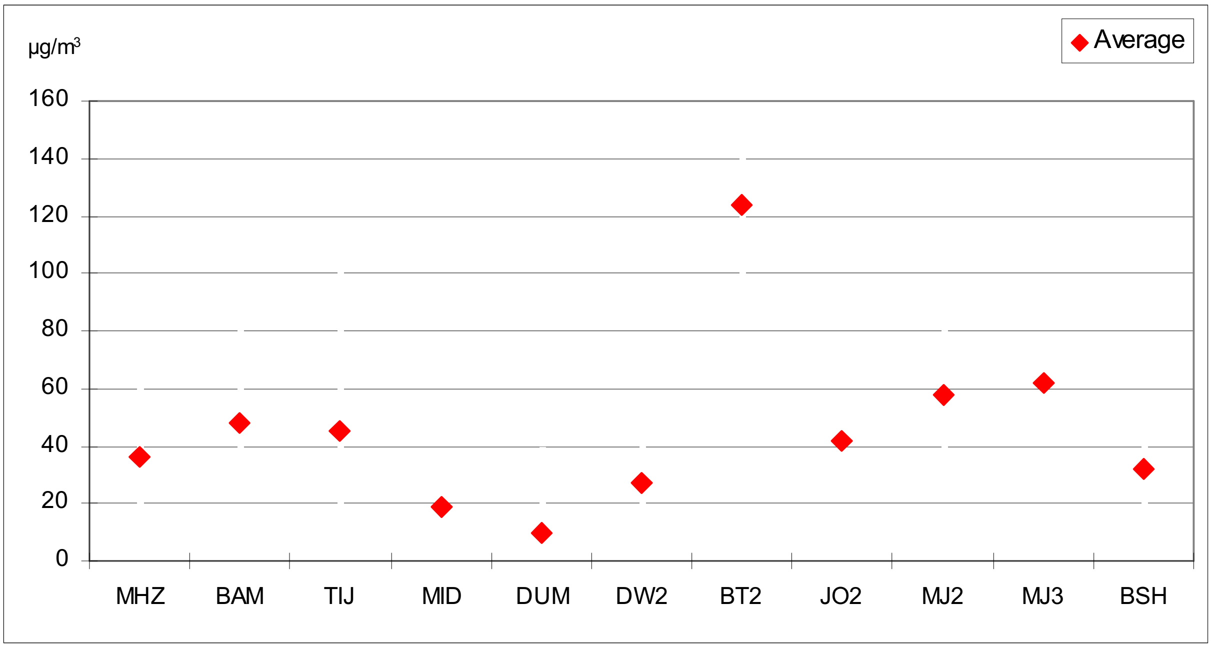
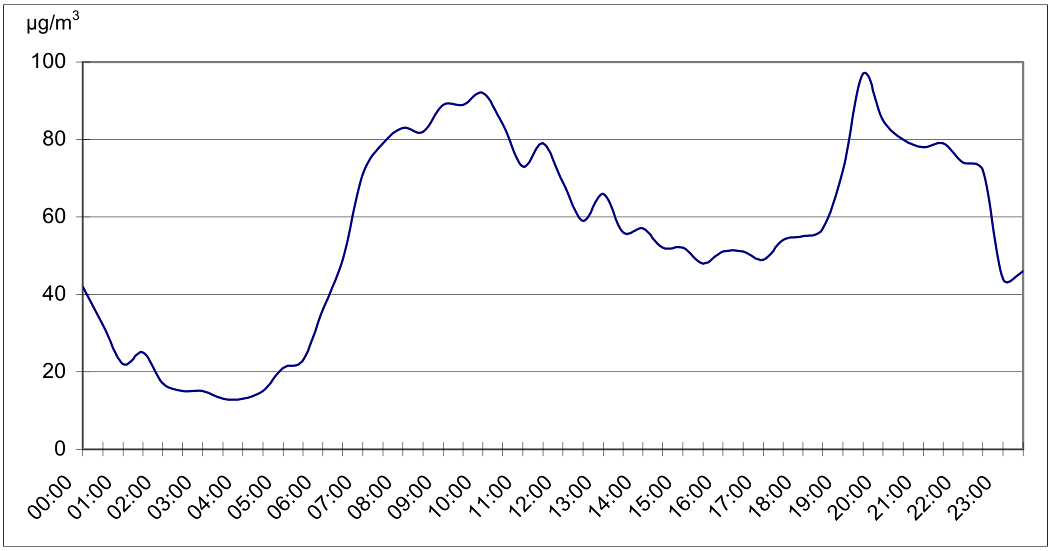


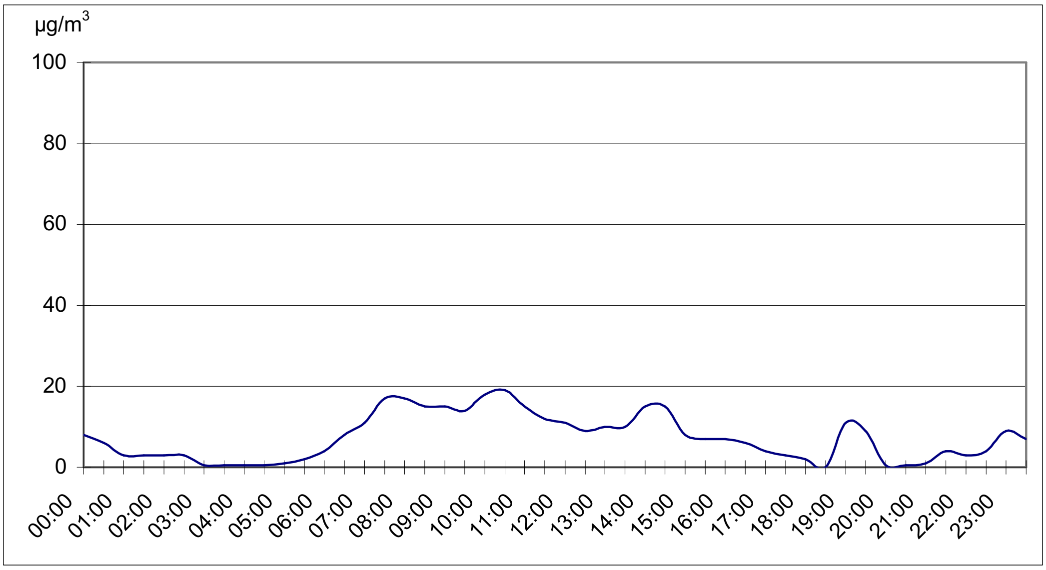
Figure 20: Mean and range of 24-h average SO_2 concentrations (µg/m^3) at the monitoring sites in Damascus in 1999/2000.

One way of getting more information about the sources of pollution is to look at the variation of pollution during the day. Therefore the 'diurnal variation' of the SO_2 concentration was determined. For the diurnal variation, the average concentration for every hour of the day was calculated out of the hourly measured concentrations of all days in the monitoring period. This way, 24 concentration values were obtained for each monitoring site, which showed the concentration of SO_2 at every hour of the day. In figure 21 the diurnal variations at the monitoring sites BAM, DUM and BT2 are shown.

(a)



(b)



(c)

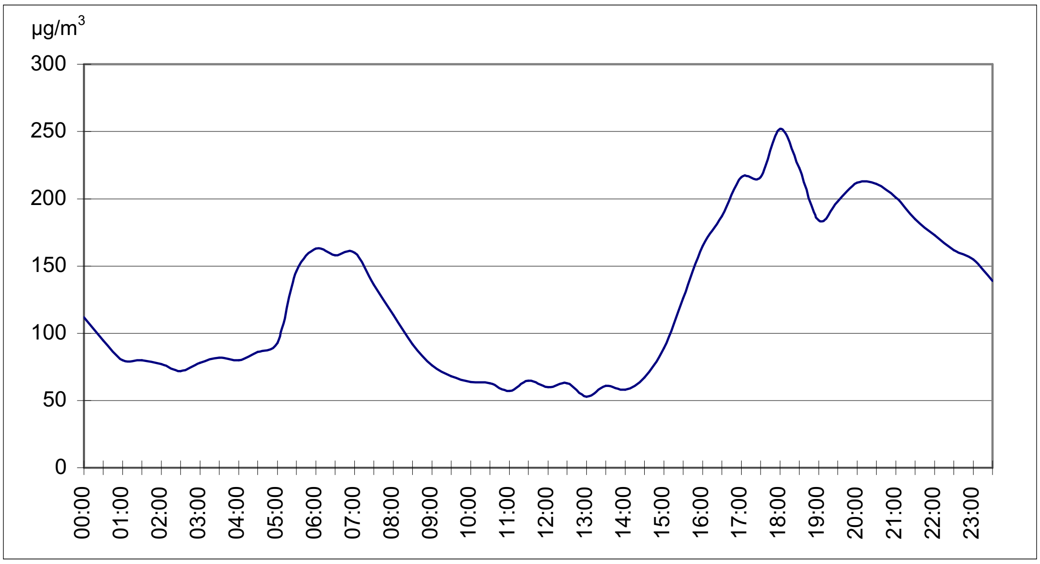


Figure 21: Diurnal variations of SO_2 concentration at BAM (a), DUM (b) and BT2 (c).

As it is demonstrated in figure 20, there was an increase in the SO_2 concentration beginning between 5 am and 6 am at BAM and BT2 and a little bit later, at 7, am in Dummar (DUM). At BAM and BT2 the concentrations increased by about 90 µg/m^3, at DUM only by about 20 µg/m^3.

At the monitoring site BAM, Baramikeh, (figure 20a) the concentration increased until about 10 am and then decreased slightly, but remained at a higher level than during the night. At about 7 pm the concentration increased rapidly again and then decreased during the night until reaching the lowest values in the early morning.

At the monitoring site DUM, Dummar, (figure 20b), the SO_2 concentration increased only a little during the morning until about 10 am and decreased during the rest of the day.

At the monitoring site BT2, Bab Tuma, (figure 20c), the diurnal variation of the SO_2 concentrations showed the same shape as at BAM, but during the day the decrease in the values reached the level of the concentrations during the night, and the evening increase started early and increased to a higher level than at BAM.

At the other monitoring sites similar diurnal variations were identified, which only differed in the level of concentrations and the shape of the peaks.

4.4.4 Nitrogen oxides

The highest average concentrations of NO_2 were obtained at the monitoring sites which suffer high traffic impact: 84 µg/m^3 (MHZ), 73 µg/m^3 (BAM) and 81 µg/m^3 (BT2). At the other monitoring sites the average concentrations lay between 24 µg/m^3 and 56 µg/m^3. The lowest value (24 µg/m^3), was observed at the monitoring site DUM in Dummar. Nevertheless at some of the monitoring sites with low average concentrations, high 1-h averages were measured. For example at DUM, where the lowest average concentration was measured, the highest 1-h value was observed.

49 µg/m^3 was determined as the overall averagee for all sites.

The average concentrations of the first measurements using the manual methods are listed in table 21. Table 22 gives the average concentrations of the continuous monitoring with the Mobile Unit. In the same table the highest and the lowest 1-h averages as well as the 98 percentile of the registered 30 minutes average concentrations are listed.

As it can be seen from table 22, the ranges of the obtained 1-h averages varied from below the detection limits of the analysers (1 µg/m^3) as high as 282 µg/m^3.

Table 21: Average concentrations of NO_2 for the complete manual monitoring period at each monitoring site, based on the registered 24-h concentration values.

Site	Period	Average concentration ($\mu g/m^3$)
BT1	05.10.99 – 18.10.99	26
JO1	20.10.99 – 31.10.99	38
DW1	02.11.99 – 14.11.99	61
MJ1	16.11.99 - 29.11.99	27

Table 22: Average concentrations of NO_2 for the continuous monitoring periods at each monitoring site, based on the 1-h concentration values, maximum and minimum 1-h averages and 98 percentiles[1] of the registered 30-min values

Site	Period	Average concentration ($\mu g/m^3$)	Minimum of the 1-h average concentrations ($\mu g/m^3$)[2]	Maximum of the 1-h average concentrations ($\mu g/m^3$)	98 percentile of 30-min concen-tration values ($\mu g/m^3$)
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	81 87	16 20	189 236	170 180
	total	84	16	236	
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 20.08.00	74 78 67	27 6 16	157 176 157	136 162 136
	total	73	6	176	
TIJ	17.06.00 – 23.06.00; 27.07.00 – 12.08.00	52 61	2 9	121 194	116 142
	total	56	2	194	
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00	39 36	5 5	138 116	101 97
	total	38	5	138	
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	26 22	< 1 < 1	282 110	95 97
	total	24	< 1	282	
DW2	28.09.00 – 04.10.00	27	2	92	77
BT2	02.11.00 – 12.11.00	81	42	148	134
JO2	20.09.00 – 26.09.00	48	2	130	111
MJ2	06.10.00 – 14.10.00	50	< 1	142	116
MJ3	26.10.00 – 31.10.00	54	6	128	114
BSH	11.09.00 – 18.09.00	41	< 1	135	89

[1]: 98 % of the concentration values were below this concentration.
[2]: in case of values below the detection limit of the analyser (1 $\mu g/m^3$), '< 1' was indicated.

The highest 98 percentiles (for explanation see chapter 4.4.3) of the 30-min concentration values were found at the same monitoring sites where the highest average concentrations were determined (MHZ, BAM, BT2). The lowest 98 percentile was found at the monitoring site DW2 in Dwella. At the site DUM the 98 percentile was 97 µg/m³, although, the highest 1-h average of 282 µg/m³ was also measured there.

Figure 22 gives an overview of the distribution of NO_2 in Damascus. The highest bars, representing average concentration, can be found at the monitoring sites near streets with high traffic flow.

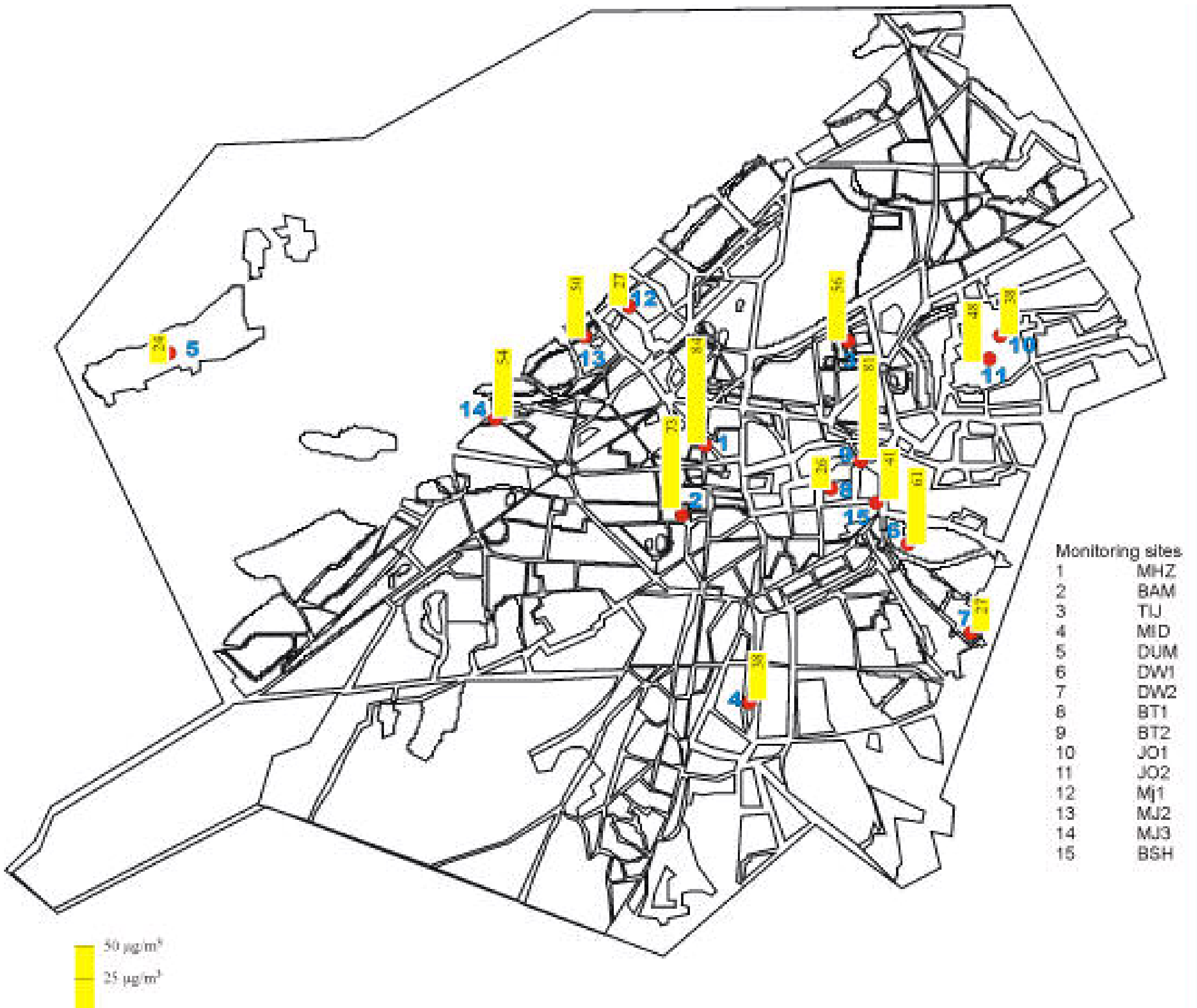


Figure 22: Average NO_2 concentrations (µg/m³) at the monitoring sites in Damascus in 1999/2000.

In table 23 the mean, maximum and minimum values of the calculated 24-h average NO_2 concentrations are listed. As in the case of the overall average concentrations, the highest values were determined at the monitoring sites BT2, MHZ and BAM.

Table 23: Mean, maximum and minimum of 24–h average concentrations of NO_2 for the continuous monitoring periods at each monitoring site.

Site	**Period**	**Average 24-h concentration (µg/m³)**	**Minimum of the 24-h concentrations (µg/m³)**	**Maximum of the 24-h concentrations (µg/m³)**
MHZ	16.05.00 – 22.05.00;	79	40	106
	25.06.00 – 01.07.00	88	74	115
	total	83	40	115
BAM	24.05.00 – 30.05.00;	73	45	91
	03.07.00 – 09.07.00;	85	77	93
	14.08.00 – 20.08.00	72	72	90
	total	74	45	93
TIJ	17.06.00 – 23.06.00;	52	19	68
	27.07.00 – 12.08.00	55	36	70
	total	54	19	70
MID	09.06.00 – 15.06.00;	38	26	47
	19.07.00 – 25.07.00	31	21	42
	total	35	21	47
DUM	01.06.00 – 07.06.00;	30	12	51
	11.07.00 – 17.07.00	28	8	49
	total	29	8	51
DW2	28.09.00 – 04.10.00	28	16	40
BT2	02.11.00 – 12.11.00	81	73	93
JO2	20.09.00 – 26.09.00	50	36	58
MJ2	06.10.00 – 14.10.00	49	22	68
MJ3	26.10.00 – 31.10.00	55	47	66
BSH	11.09.00 – 18.09.00	39	18	68

Figure 23 shows the mean and range of the 24-h averages of NO_2 at the monitoring sites in Damascus.

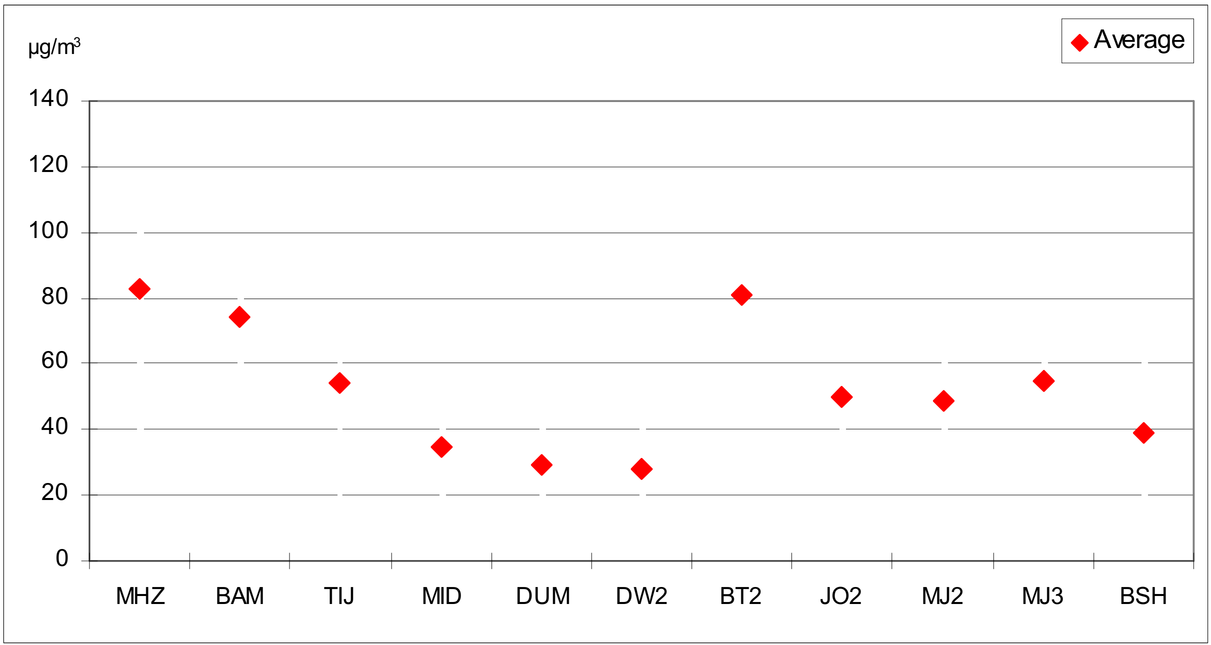


Figure 23: Mean and range of 24-h average NO_2 concentrations (µg/m^3) at the monitoring sites in Damascus in 1999/2000.

The highest mean 24-h values were obtained at the monitoring sites BT2, MHZ and BAM. At BT2 the single 24-h value did not differ very much, all values were on the same level. The variation of the values at MHZ and BAM was due to the very low values observed on Fridays during the monitoring period.

The diurnal variations of the NO_2 concentration (for explanation see chapter 4.4.3) at the monitoring sites showed almost the same shape as in the case of SO_2: one peak in the morning and one in the evening. Only at the monitoring site MHZ a third peak in the early afternoon was observed. As an example, figure 24 demonstrates the diurnal variation of the NO_2 concentration at the monitoring sites MHZ and DUM.

(a)

(b)

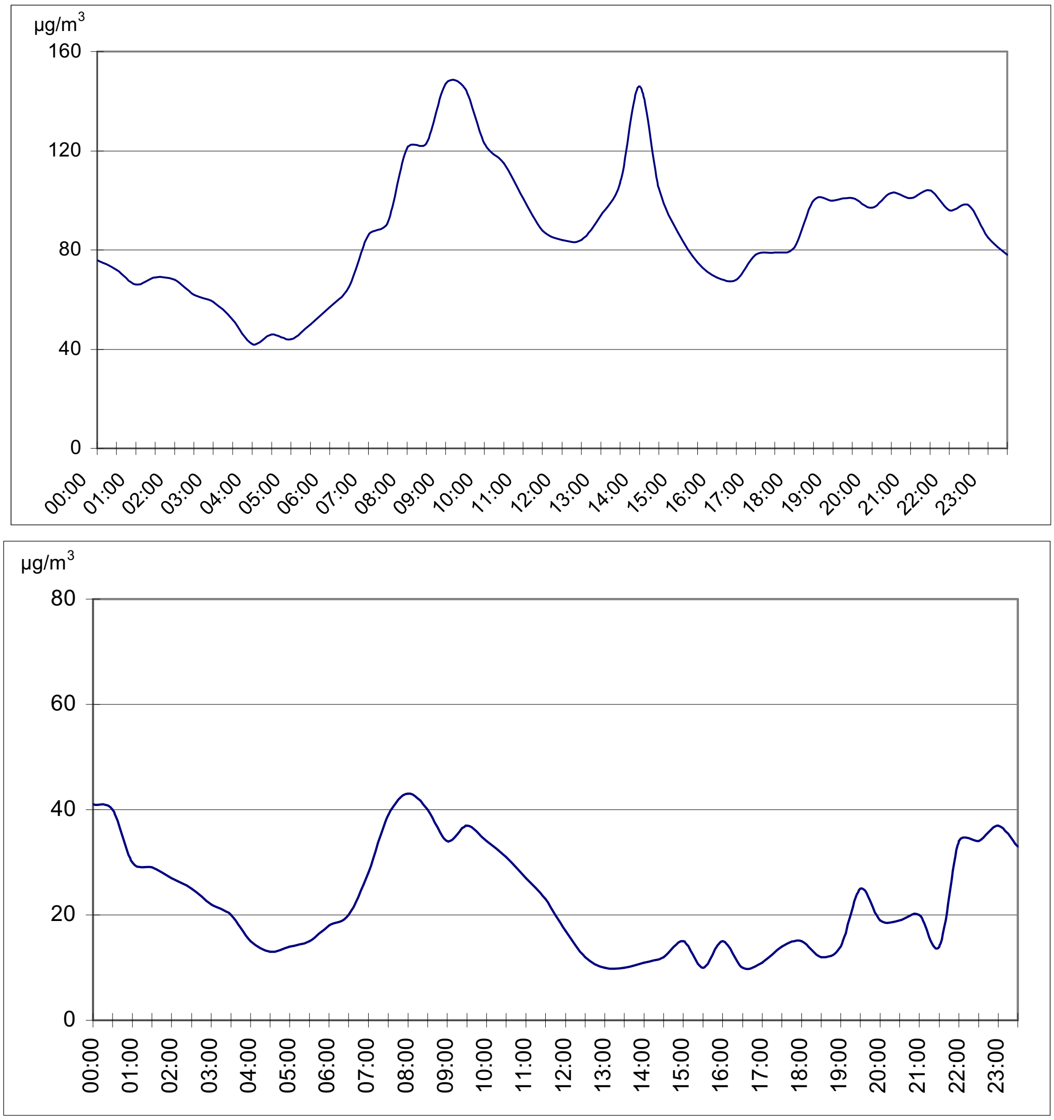


Figure 24: Diurnal variations of NO_2 concentration at MHZ (a) and DUM (b).

As it can be seen in figure 22 there was an increase in the NO_2 concentration at the monitoring site MHZ between 7 am and 9 am in the morning which reached the highest level at 9:30 am. Until the early afternoon the concentration decreased, but only to a level which was twice as high as the level during the night. At about 2 pm the concentration increased again, but this second peak lasted only 1,5 hours. In the evening (7 pm) a third increase was observed. This time the concentrations reached only to about 100 µg/m^3 but stayed stable at this level until 11 pm.

At the monitoring site DUM an increase of the NO_2 concentration could be observed in the morning at the same time but on a significantly lower level. During the day the concentration stayed stable, between 10 µg/m^3 and 20 µg/m^3. Late at night, between 10 pm and 12 pm a slight increase was determined.

The NO average concentrations at most of the monitoring sites were between 10 µg/m^3 and 60 µg/m^3. At the MID monitoring site in Midan the lowest average (7 µg/m^3) was observed and at the BT2 site at the Bab Tuma square, the highest average concentration was observed. Nevertheless, even at monitoring sites with low average concentration values (p. ex. DUM, TIJ, MJ3, JO2) high maximum 1-h averages were determined. However as can been seen from the 98 percentiles, the high maximum values represent only some single events during the monitoring. For example, at TIJ a 1-h maximum value of 719 µg/m^3 was obtained, but 90 % of the values were below 100 µg/m^3.

44 µg/m^3 was determined as the overall average for all sites.

Table 24 gives the average concentrations of the continuous monitoring with the Mobile Unit. In the same table the highest and the lowest 1-h averages as well as the 98 percentile of the registered 30 minutes average concentrations are listed.

In figure 25 the average NO concentrations at the monitoring sites in Damascus are demonstrated. It is evident that those sites which were influenced by traffic movement showed a higher pollution from NO than those sites in residential areas without any direct impact of high traffic like DUM, MID, DW2 or JO2.

Table 24: Average concentrations of NO for the continuous monitoring periods at each monitoring site, based on the 1-h concentration values, maximum and minimum 1-h averages and 98 percentiles[1] of the registered 30-min values

Site	Period	Average concentration ($\mu g/m^3$)	Minimum of the 1-h average concentrations ($\mu g/m^3$)[2]	Maximum of the 1-h average concentrations ($\mu g/m^3$)	98 percentile of 30-min concentration values ($\mu g/m^3$)
MHZ	16.05.00 – 22.05.00;	60	2	269	209
	25.06.00 – 01.07.00	50	1	222	154
	total	55	1	269	
BAM	24.05.00 – 30.05.00;	39	1	156	120
	03.07.00 – 09.07.00;	43	2	244	191
	14.08.00 – 20.08.00	42	< 1	223	183
	total	41	< 1	244	
TIJ	17.06.00 – 23.06.00;	18	< 1	224	121
	27.07.00 – 12.08.00	60	< 1	719	593
	total	39	< 1	719	
MID	09.06.00 – 15.06.00;	6	< 1	48	28
	19.07.00 – 25.07.00	9	< 1	61	47
	total	7	< 1	61	
DUM	01.06.00 – 07.06.00;	9	< 1	269	73
	11.07.00 – 17.07.00	12	< 1	209	140
	total	10	< 1	269	
DW2	28.09.00 – 04.10.00	11	< 1	153	126
BT2	02.11.00 – 12.11.00	170	15	731	587
JO2	20.09.00 – 26.09.00	21	< 1	148	131
MJ2	06.10.00 – 14.10.00	52	1	415	204
MJ3	26.10.00 – 31.10.00	59	< 1	355	258
BSH	11.09.00 – 18.09.00	16	< 1	195	106

[1]: 98 % of the concentration values were below this concentration.
[2]: in case of values below the detection limit of the analyser (1 $\mu g/m^3$), '< 1' was indicated.

The diurnal variations of the NO concentrations (for explanation see chapter 4.4.3) at all sites were similar to the variations determined for the NO_2 concentrations: peaks in the morning and in the evening. At the MHZ monitoring site a third peak was determined as in the case of NO_2.

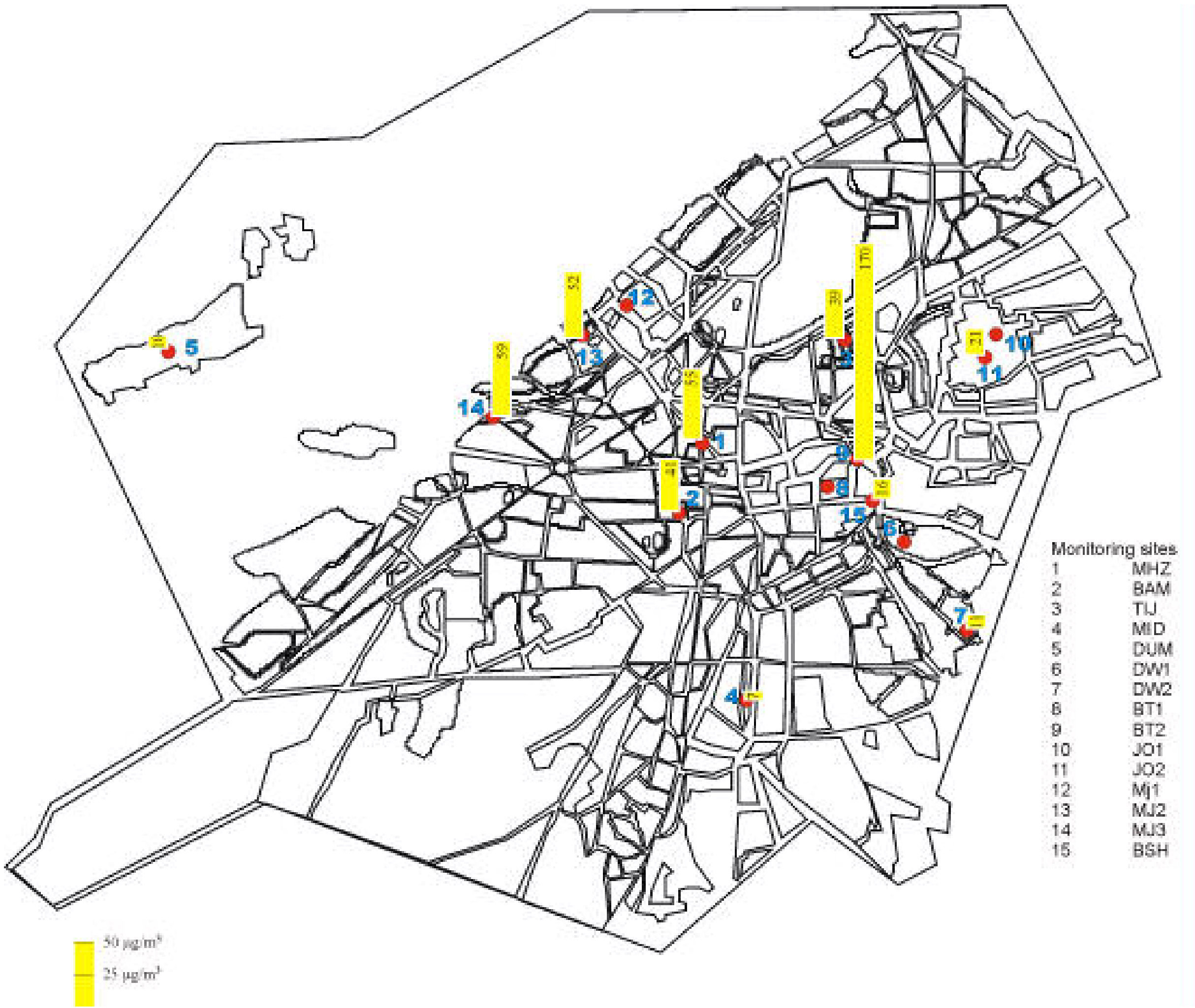


Figure 25: Average NO concentrations (µg/m^3) at the monitoring sites in Damascus in 1999/2000.

4.4.5 Carbon monoxide

The lowest average concentrations of CO (0.5 mg/m^3 and 0.3 mg/m^3) were obtained at the monitoring sites DUM ant DW2, and the highest one (10.9 mg/m^3) at BT2. At the other sites the average concentration lay between 1 mg/m^3 and 5 mg/m^3. 2.8 mg/m^3 was determined as the overall average for all sites.

At almost all monitoring sites the minimum 1-h averages were below the detection limit of the analyser (0.1 mg/m^3), only at MHZ and BT2 even the lowest values are higher than the overall averages at some of the other sites.

The maximum 1-h average concentrations at most of the sites lay above 10 mg/m^3 as well as the 98 percentile of the measured 30-min concentration (for explanation see chapter 4.4.3).

This indicates that a considerable number of concentration values were high. For example, at the monitoring site BT2 at Bab Tuma square the maximum 1-h average concentration was equal to the 98 percentile of the 30-min concentrations. In this case about 18 % of all measured value lay above 15 mg/m³.

Table 25 gives the average concentrations of the continuous monitoring with the Mobile Unit. In the same table the highest and the lowest 1-h averages as well as the 98 percentile of the registered 30 minutes average concentrations are listed.

Table 25: Average concentrations of CO for the continuous monitoring periods at each monitoring site, based on the 1-h concentration values, maximum and minimum 1-h averages and 98 percentiles[1] of the registered 30-min values

Site	Period	Average concentration (mg/m^3)	Minimum of the 1-h average concentrations (mg/m^3)[2]	Maximum of the 1-h average concentrations (mg/m^3)	98 percentile of 30-min concentration values (mg/m^3)
MHZ	16.05.00 – 22.05.00;	3.0	0.9	9.1	6.3
	25.06.00 – 01.07.00	3.8	< 0.1	16.6	9.7
	total	3.4	< 0.1	16.6	
BAM	24.05.00 – 30.05.00;	1.7	< 0.1	5.0	3.6
	03.07.00 – 09.07.00;	2.1	< 0.1	6.4	6.6
	14.08.00 – 20.08.00	2.5	< 0.1	12.5	8.7
	total	2.1	< 0.1	12.5	
TIJ	17.06.00 – 23.06.00;	1.4	< 0.1	6.4	5.2
	27.07.00 – 12.08.00	3.4	< 0.1	19.7	18.7
	total	2.4	< 0.1	19.7	
MID	09.06.00 – 15.06.00;	0.9	< 0.1	4.9	2.9
	19.07.00 – 25.07.00	1.0	< 0.1	4.1	2.9
	total	1.0	< 0.1	4.9	
DUM	01.06.00 – 07.06.00;	0.4	< 0.1	3.0	2.6
	11.07.00 – 17.07.00	0.6	< 0.1	10.9	7.1
	total	0.5	< 0.1	10.9	
DW2	28.09.00 – 04.10.00	0.3	< 0.1	4.7	3.5
BT2	02.11.00 – 12.11.00	10.5	2	20.0	20.0
JO2	20.09.00 – 26.09.00	1.2	< 0.1	12.6	6.9
MJ2	06.10.00 – 14.10.00	5.0	< 0.1	14.7	10.4
MJ3	26.10.00 – 31.10.00	3.2	< 0.1	14.1	11.4
BSH	11.09.00 – 18.09.00	0.9	< 0.1	6.1	4.8

[1]: 98 % of the concentration values were below this concentration.
[2]: in case of values below the detection limit of the analyser (0.1 mg/m³), '< 0.1' was indicated.

In figure 26 the average CO concentrations at the monitoring sites in Damascus are shown. It is evident that those sites which were influenced by traffic movement showed a higher pollution of CO than those sites in residential areas without any direct impact of high traffic like DUM, MID, DW2 or JO2.

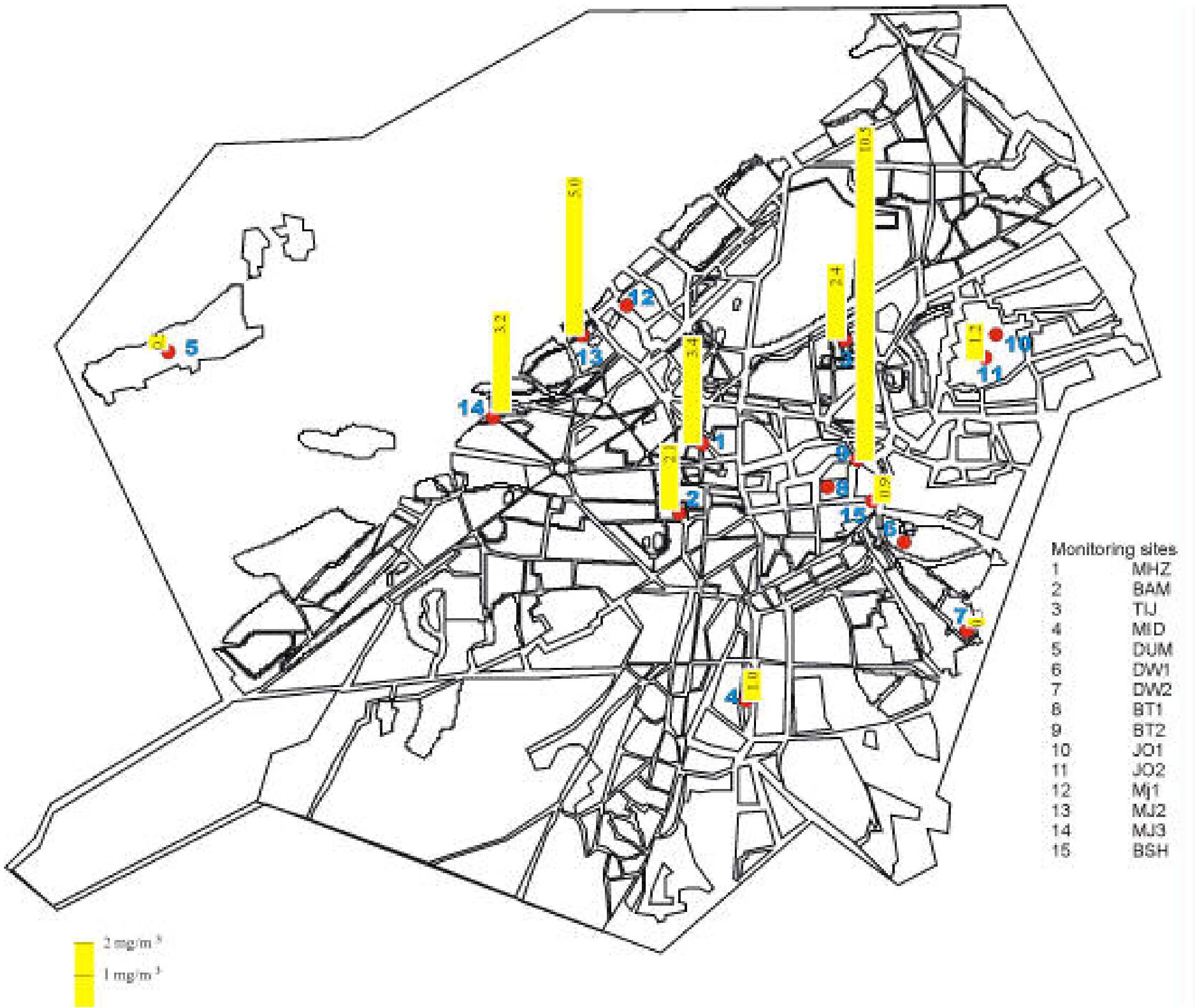
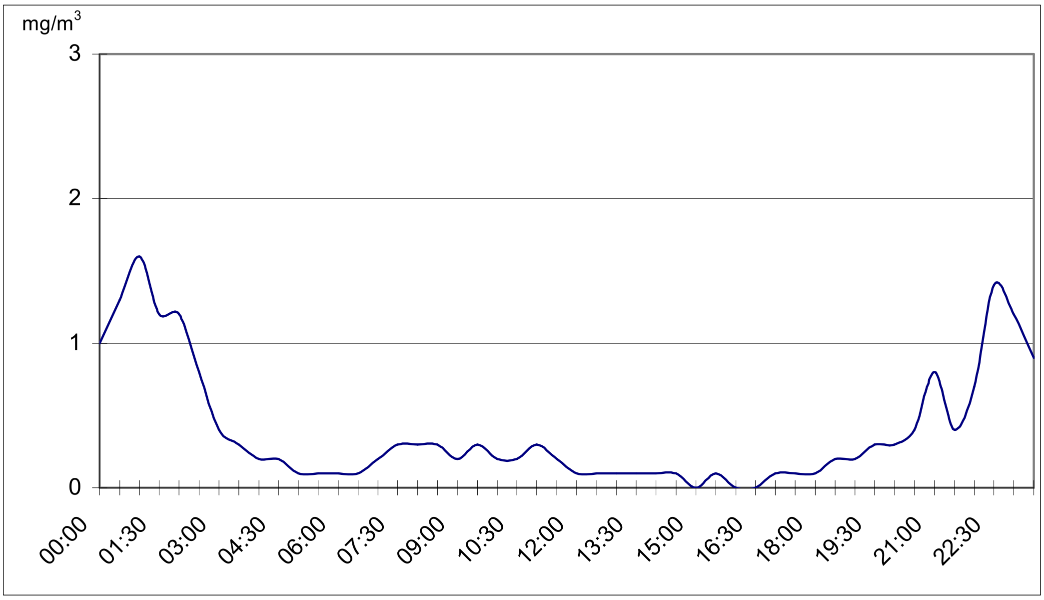


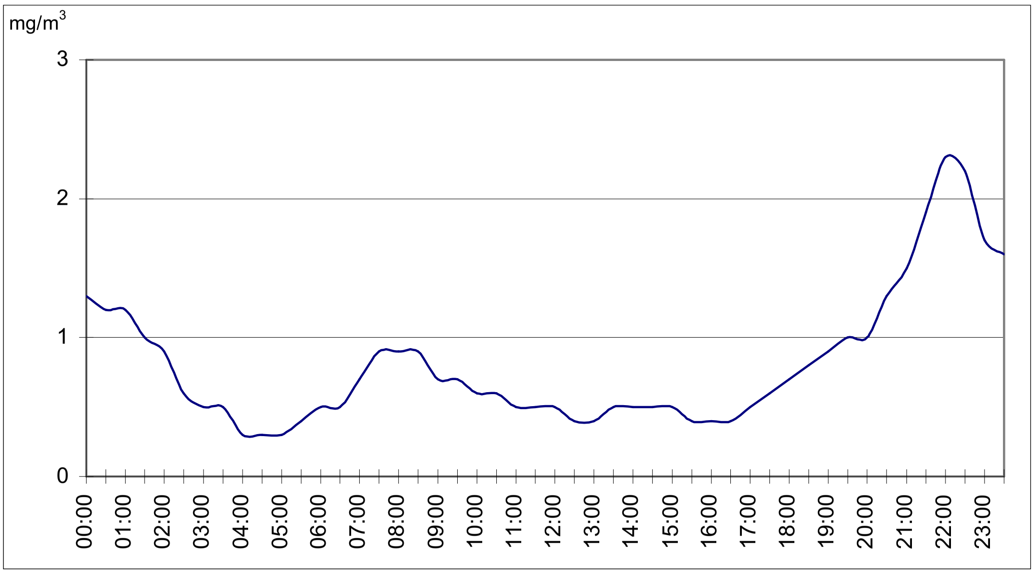
Figure 26: Average CO concentrations (mg/m^3) at the monitoring sites in Damascus in 1999/2000.

As examples for the diurnal variation of the CO concentrations during the day, the diurnal variations determined at the monitoring site DM, MID and BT2 are demonstrated in figure 27.

(a)



(b)



(c)

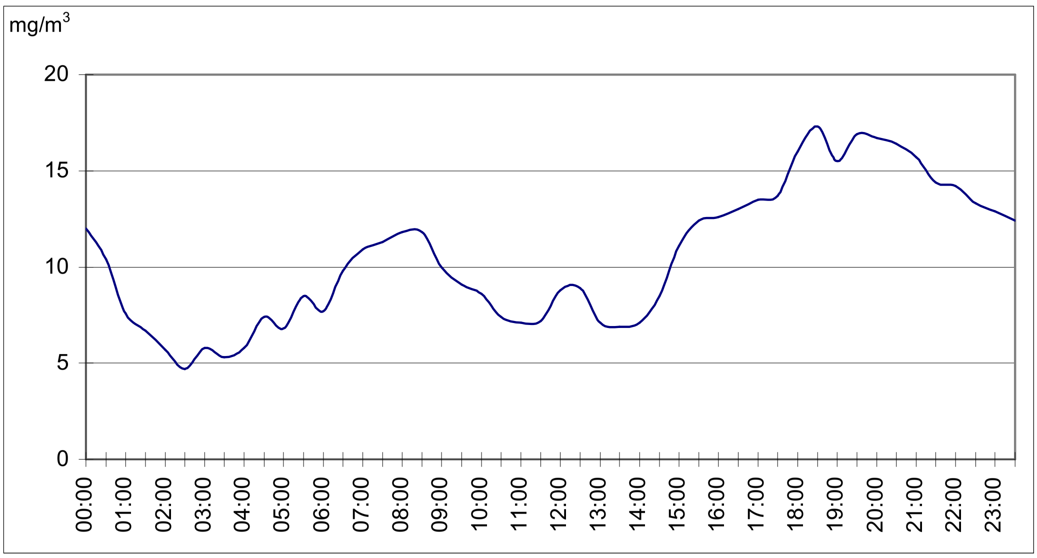


Figure 27: Diurnal variations of CO concentration at DUM (a), MID (b) and BT2 (c).

As shown in figure 27, the CO concentration increased slightly in the morning and stayed on this higher level until midday. A higher increase of the concentration could be observed during the night beginning at about 8 pm. This peak remained until the early morning.

At the monitoring site in Midan (MID) the diurnal variation showed the same shape as at DUM but on a higher level. The morning peak was also more significant.

At the monitoring site BT2 at the Bab Tuma square the CO concentration increased in the early morning and reached the top level between 8 am and 9 am. During the morning and early afternoon the concentration stabilised to a level of about 7 mg/m^3 and increased again at about 3 pm to high concentrations of about 17 mg/m^3.

One of the standards for the evaluation of air pollution by CO is the 8 hour average concentration. Therefore, the rolling 8-h averages of the measured CO concentrations were determined. This involves calculating an average concentration from the beginning of the monitoring period until the end for each 8 hours interval. In table 26 the maximum and the average 8-h values are listed.

Table 26: Average 8-h concentrations and maximum 8-h concentrations of CO for the continuous monitoring periods at each monitoring site.

Site	**Period**	**Average of the 8-h concentrations (mg/m^3)**	**Maximum of the 8-h concentrations (mg/m^3)**
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	3.0 3.8	5.3 6.9
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 20.08.00	1.7 2.2 2.7	3.2 4.1 6.0
TIJ	17.06.00 – 23.06.00; 27.07.00 – 12.08.00	1.4 3.2	3.9 14.8
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00	0.8 0.6	2.3 1.7
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	0.4 0.5	2.1 4.8
DW2	28.09.00 – 04.10.00	0.1	3.2
BT2	02.11.00 – 12.11.00	10.6	18.3
JO2	20.09.00 – 26.09.00	1.3	4.6
MJ2	06.10.00 – 14.10.00	2.4	6.2
MJ3	26.10.00 – 31.10.00	3.0	8.0
BSH	11.09.00 – 18.09.00	0.8	3.5

The distribution of the 8-h values is almost the same as for the average concentrations listed in table 25. The highest values were observed at the monitoring site BT2. On every day during of the monitoring period the 8-h average concentrations were above 10 mg/m^3.

Although the average CO concentration at the monitoring site TIJ is relatively low (2.4 mg/m^3), on two days the 8-h averages were higher than 10 mg/m^3 in the evening.

Figure 28 shows the highest 8-h average concentration of CO at every monitoring site in Damascus.

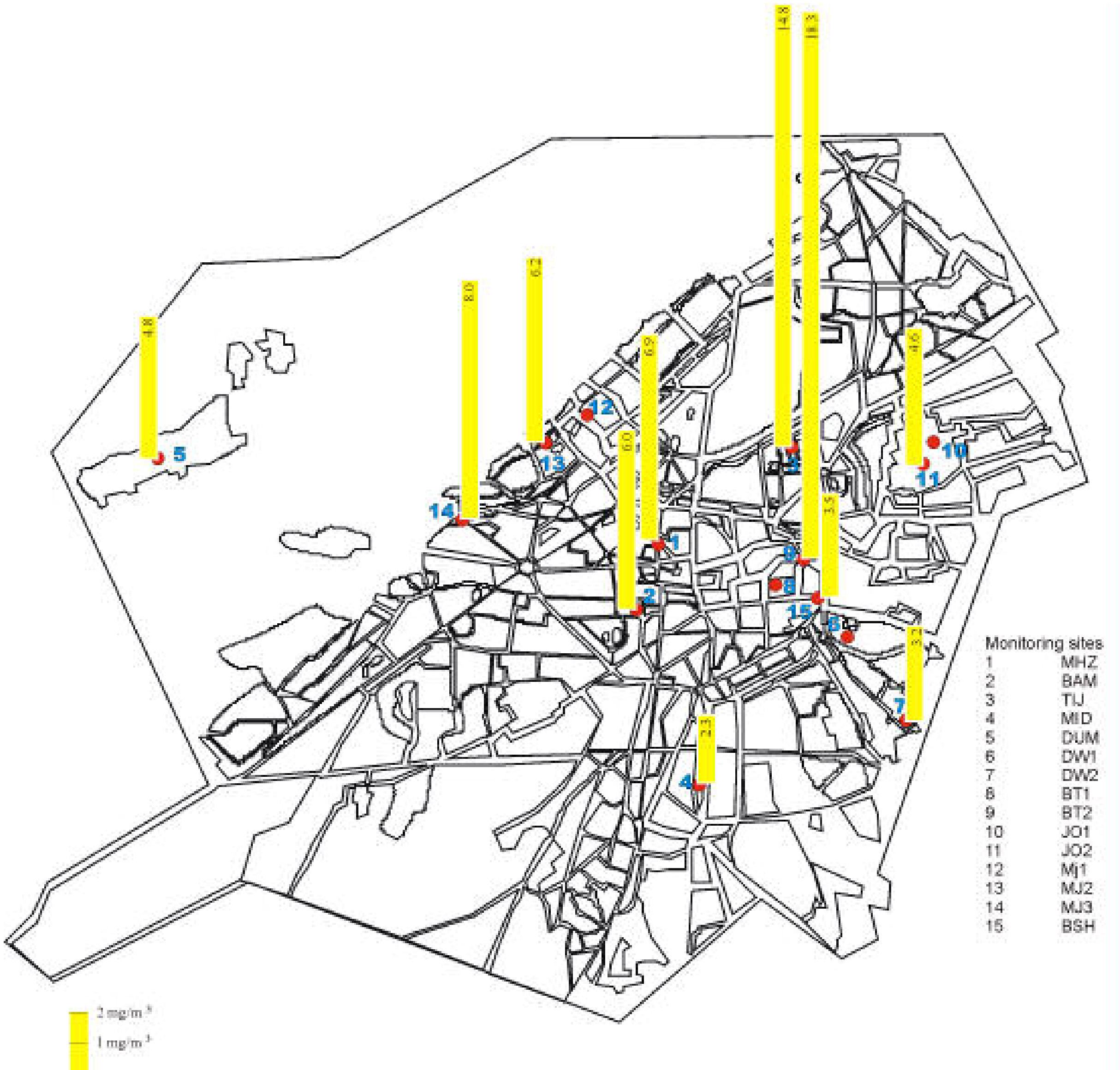


Figure 28: Maximum 8-h average CO concentrations (mg/m^3) at the monitoring sites in Damascus in 1999/2000.

4.4.6 Meteorological parameters

The main meteorological parameters influencing the dispersion and dilution of pollutants in air are the wind velocity and wind direction. Therefore, the Mobile Unit was equipped with sensors to measure the wind velocity and wind direction parallel to the concentration of pollutant. The air temperature as well as the relative air humidity and precipitation data were provided by the General Directorate of Meteorology, Damascus.

In table 27 the monthly average values of air temperature and relative humidity are listed for the months when the monitoring was executed.

Table 27: Monthly averages of air temperature and relative humidity (source: General Directorate of Meteorology).

Month	average temperature °C	minimum temperature °C	maximum temperature °C	relative humidity %
October 1999	19			53
November 1999	12			47
May 2000		11	31	42
June 2000		16	34	45
July 2000		18	41	39
August 2000		18	38	48
September 2000		17	33	52
October 2000		14	25	55
November 2000[1]		10	24	43

[1]: 01.11.00 – 12.11.00

Precipitation was only measured on 7 days during the monitoring, as listed in table 28. Due to the low rainfall no down-wash effect could be observed.

Table 28: Days monitored and quantity of precipitation during the air quality monitoring in Damascus (source: Meteorological Department [18]).

Day	Precipitation mm
14.10.99	1.7
16.10.00	2.7
17.10.00	3.8
25.10.00	2.3
26.10.00	1.2
27.10.00	1.5
28.10.00	1.2

The average and maximum wind velocities as measured during the monitoring periods at the different monitoring sites are listed in table 29.

The meteorological conditions described by the above mentioned data were in the range of the long-term meteorological data registered by the Meteorological Department, Damascus, for the last 40 years [18]. Therefore, it can be assumed that the obtained monitoring data is representative for the monitoring period.

Table 29: Average and maximum wind velocities measured at the monitoring sites during the monitoring periods.

Site	**Period**	**Average wind velocity (m/s)**	**Maximum wind velocity (m/s)**
MHZ	16.05.00 – 22.05.00; 25.06.00 – 01.07.00	2.2 2.0	4.0 4.3
BAM	24.05.00 – 30.05.00; 03.07.00 – 09.07.00; 14.08.00 – 20.08.00	2.5 2.7 1.9	6.6 6.5 4.5
TIJ	17.06.00 – 23.06.00; 27.07.00 – 12.08.00	1.3 1.9	3.1 5.2
MID	09.06.00 – 15.06.00; 19.07.00 – 25.07.00	0.8 2.0	4.4 4.7
DUM	01.06.00 – 07.06.00; 11.07.00 – 17.07.00	2.6 0.9	5.5 6.7
DW2	28.09.00 – 04.10.00	1.9	4.9
BT2	02.11.00 – 12.11.00	0.9	1.5
JO2	20.09.00 – 26.09.00	1.3	2.6
MJ2	06.10.00 – 14.10.00	2.3	5.3
MJ3	26.10.00 – 31.10.00	1.4	3.2
BSH	11.09.00 – 18.09.00	1.5	3.3

The average wind velocities do not differ very much. The low average and maximum velocities at the monitoring site BT2 are remarkable, and could be one reason for the high concentrations at this site. At the other sites with high concentrations (MHZ, BAM, MJ2) relatively, high velocities were measured.

At all monitoring sites a regular course of wind velocities during the day could be observed. In figure 29 the diurnal variations of the wind velocity measured at the monitoring sites (BAM, BSH, MID, MJ3) are shown.

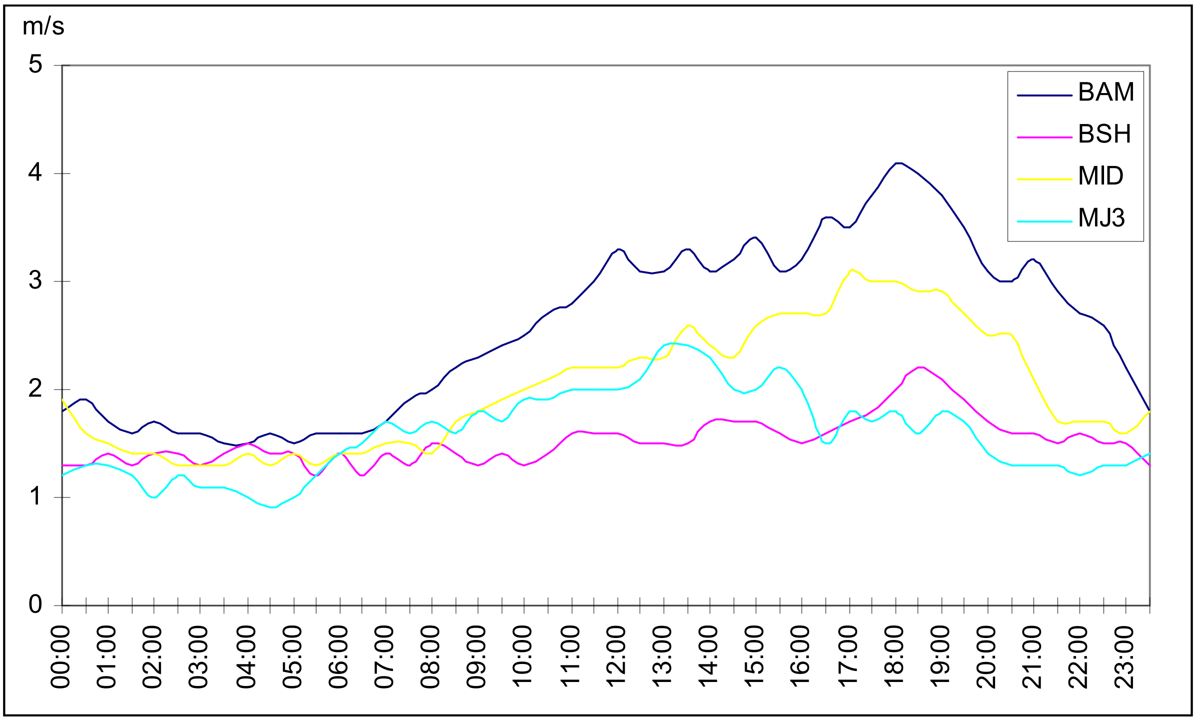


Figure 29: Diurnal variations of the wind velocity obtained at four monitoring sites (BAM, BSH, MID, MJ3).

The wind velocity increased during the morning and reached the highest level in the afternoon. During the night the wind calmed down.

4.5 Conclusions

The essential criterium for the evaluation of air quality is the comparison of the obtained concentration values with the established air quality standards (table 2). There are long-term standards (for 1 year) and short-term standards for 24 hours or shorter periods. Due to the limited period of monitoring, the obtained data does not correspond to annual averages. Nevertheless, in order to get information about long-term pollution, the averages obtained at each monitoring site can be seen as the first step in getting long-term values.

Besides the comparison of air quality standards, a comparison among the different monitoring sites and with other cities or areas could enhance the evaluation of data obtained about the air quality during the pilot monitoring.

Total Suspended Particulates (TSP)

- The comparison of the TSP average concentrations determined at 13 monitoring sites exceeded the annual standards established in the Syrian Proposal for air quality standards (90 $\mu g/m^3$) and in the German regulations (150 $\mu g/m^3$). Only at the MJ3 monitoring site the average concentration (86 $\mu g/m^3$) was below the standards.
- The 24 hour standard of the Syrian Proposal (150 $\mu g/m^3$) was also exceeded at all monitoring sites with the exclusion of MJ3. At 9 monitoring sites (MHZ, BAM, TIJ, MID, DW1, BT2, JO1, MJ1 and MJ2) even the minimum 24-h average concentration was higher than this standard. In total 84 % of the measured 24-h concentration exceeded this standard.
- In general there was no significant difference between the TSP concentration obtained at monitoring sites in the streets and monitoring sites in residential areas. Concerning the composition of the particles sampled at the different sites, an evident difference could be observed during the monitoring although an analysis of the components were not undertaken. The particles sampled in the streets (p. ex.: MHZ, BAM, BT2) were black and fine. At the other monitoring sites the particles were not so dark, and some were even light brown and coarse at those sites which were not influenced by high traffic. As examples, two filters from DUM and MHZ representing high TSP concentrations are shown in figure 30.

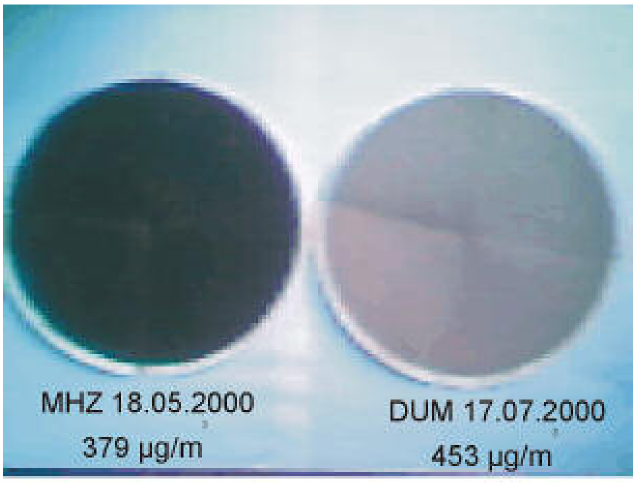


Figure 30: Loaded filter from MOUHAFAZA monitoring site (MHZ) on 18.05.2000 and DUMMAR monitoring site (DUM) on 17.07.2000.

The most important origin of the fine black particles in the streets are the vehicles: fuel, especially diesel, combustion and the loss of rubber from the wheels. The bright sand coloured particles which were the main particles at the monitoring sites away from the streets are presumably of natural origin or from construction sites.

- During the presented pilot monitoring the concentration of total suspended matter was measured. For the evaluation of effects of air pollution on health, the study of the respirable part of the particles will get more and more important. In order to estimate the part of small particles with diameters below 10 µm (PM_{10}), a factor can be used which represents the contribution of PM_{10} on TSP. In 1997 the Syrian Atomic Energy Commission executed a monitoring programme in some Syrian cities [19] to study the particles and their components in air. One of the results was a relation of TSP concentration to PM_{10} concentration. In Damascus, this relation, based on measurements at the MHZ monitoring site, was 51 %. That means 51 % of all sampled particles had a diameter less than 10 µm.

  Taking this factor as a first attempt to estimate the PM10 concentrations at all the monitoring sites in Damascus, the resulting average concentrations would be between 41 µg/m^3 and 188 µg/m^3; the range of the highest 24-h concentrations would be 69 µg/m^3 to 266 µg/m^3. All those estimated values exceed the existing standards for PM10 in Europe (annual average: 40 µg/m^3; 24-h average: 50 µg/m^3).

Sulphur dioxide (SO_2)

- The average concentration of SO_2 determined at the monitoring site BT2 exceeded the annual standard of the Syrian Proposal (80 µ/m^3). The annual standard established by the WHO (50 µ/m^3) was exceeded at BT2, MJ2 and MJ3. At the other monitoring sites the concentration reached between 10 % and 76 % of these standards.

– The 1-h standard established in the Syrian Proposal and European directives (350 µg/m^3) was exceeded twice at the monitoring site BT2. The 1-h values determined at the other monitoring sites were between 15 % and 67 % of this standard.

– 55 % of the 24-h average concentrations determined at the monitoring site BT2 exceeded the established 24 –h standard (125 µg/m^3) for SO_2. At the monitoring site TIJ the highest 24-h values reached 89 % of this standard. At all other sites the highest 24-h concentration lay in a range of 22 % to 66 % of the standard.

– The German short-term standard for 98 percentile was not exceeded.

– A reason for the high concentrations at the monitoring site BT2 in comparison to all other sites is the synergy of various factors:
  - a site with strong traffic influence
  - relatively closed area with bad dispersion conditions
  - beginning of the heating period in the residential area (Bab Tuma)
  - very large number of vehicles were minibusses and a bus-stop was located in the neighbourhood
  - school busses passed through the site to enter the old city.

– Due to moderate car traffic, a low frequency of minibusses, and the centralised heating stations, the concentration of SO_2 at the monitoring site DUM was comparably low.

Nitrogen dioxide (NO_2)

– The annual standard for NO_2 concentrations established in the Syrian Proposal (100 µg/m^3) was not exceeded. The standard for annual averages established by the WHO and the European Union (40 µg/m^3) was exceeded at all monitoring sites with the exception of Mid, DUM and DW2.

– The standard for 1-h concentration in the Syrian Proposal (400 µg/m^3) was not exceeded. The European and WHO standard of 200 µg/m^3 was exceeded at MHZ and DUM, but at MHZ only 2 values and at DUM only 1 value were above the standard.

– The standard for 24-h concentration established in the Syrian Proposal (150 µg/m^3) was not exceeded by the 24-h average concentrations determined.

Carbon monoxide (CO)

– A long-term standard for CO concentration was established only in the German regulations. This standard (10 mg/m^3) was exceeded only at the monitoring site BT2. At the other sites the obtained average concentration lay between 9 % and 50 % of this standard.

– The 1-h standard of 30 mg/m³ was not exceeded. The determined 1-h concentrations reached 16 % to 67 % of this standard.

– The 8-h standard established in the Syrian Proposal and by the WHO (10 mg/m³) was exceeded at the monitoring sites BT2 and TIJ. Considering the rolling 8-h average concentrations calculated, 40 % of the results exceeded the standard at BT2 and 5 % at TIJ. Considering the consecutive 8-h averages (00:00-08:00, 08:00-16:00, 16:00-24:00), 39 % of the values were above the standard value at BT2 and none at TIJ. At all other sites the determined rolling 8-h average concentrations lay between 17 % and 80 % of the standard.

General

– The monitoring presented was mainly carried out during summer. The contribution of emission by heating, which is one of the essential sources of air pollution in Damascus, could not be considered. Therefore, it can be assumed that, probably, the concentrations of the monitored air pollutants will be higher and this will also increase the long-term averages.

– All diurnal variations of the gaseous pollutants showed comparable shapes: one peak in the morning and one in the evening. This corresponds to the increase in traffic at these times. During the day the concentration stayed on a relatively constant level, which was higher in traffic influenced monitoring sites than in sites in residential areas. All this indicates, traffic as the main source of the air pollution detected during the monitoring.

– Another hint of the probable sources of pollution can be obtained by studying the pollution roses. A pollution rose demonstrates the average concentration for every wind direction. In figure 31, the pollution combined with the wind roses at the monitoring sites TIJ and BT2 are shown for nitrogen dioxide.

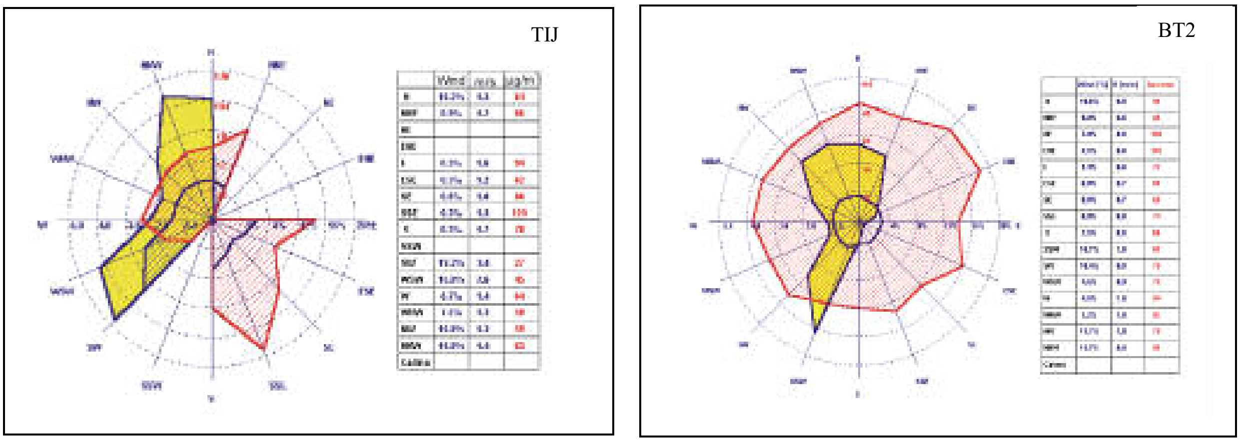


Figure 31: Wind and NO_2 pollution roses at TIJ and BT2.

The predominant wind directions at the monitoring site TIJ were SW to N; less than 2 % of the observed wind came from directions east to south. However, the highest concentrations of NO_2 were obtained when the wind came from east to south. This indicates an important source in this direction. In the case of TIJ the Abasyeen square – an area with heavy traffic movement – is situated in this direction.

At the monitoring site BT2 the main wind directions were SSW to SW and NW to NNE. For the NO_2 concentration no dominant direction could be identified. Due to the turbulence, the pollution is distributed regularly in the whole area.

– Usually air temperature decreases with increasing height. In this case the warm air from low levels raises and supports the vertical dispersion of pollutants. Under certain climate conditions this temperature gradient can be inverted, the temperature of the lower air layers is then higher than that of the higher layer.

  In wintertime a ground based thermal inversion can be observed. In the morning, during sunrise, the ground air layers are warmed up later than the higher levels and the vertical exchange of air is suppressed. At this point an inversion layer with stable meteorological condition can be observed. In such an inversion layer the pollutants are trapped and the dispersion is constrained. In Damascus this type of inversion can be observed as it is shown in figure 32.

Figure 32: View of Damascus from Casyoun Mountains, in November 1999 (a) with inversion layer, (b) without inversion layer.

The monitoring sites MJ2 and MJ3 were situated at the beginning of the incline of the Casyoun Mountains above the level of the other monitoring sites. In the morning hours, at sunrise, when the inversion layer raised, the pollutants, which were emitted in the city and kept within the inversion layer, were transported to higher levels and reached the higher located monitoring sites. Therefore, this transported pollution could contribute to the concentrations monitored at the monitoring sites MJ2 and MJ3. The high concentration peaks whiche lasted about 1 hour at these sites in the early morning support this assumption.

- In order to get a summarised view of air pollution, the determined average concentrations of the pollutants for each monitoring site were added. In figure 33 summed concentrations are illustrated.

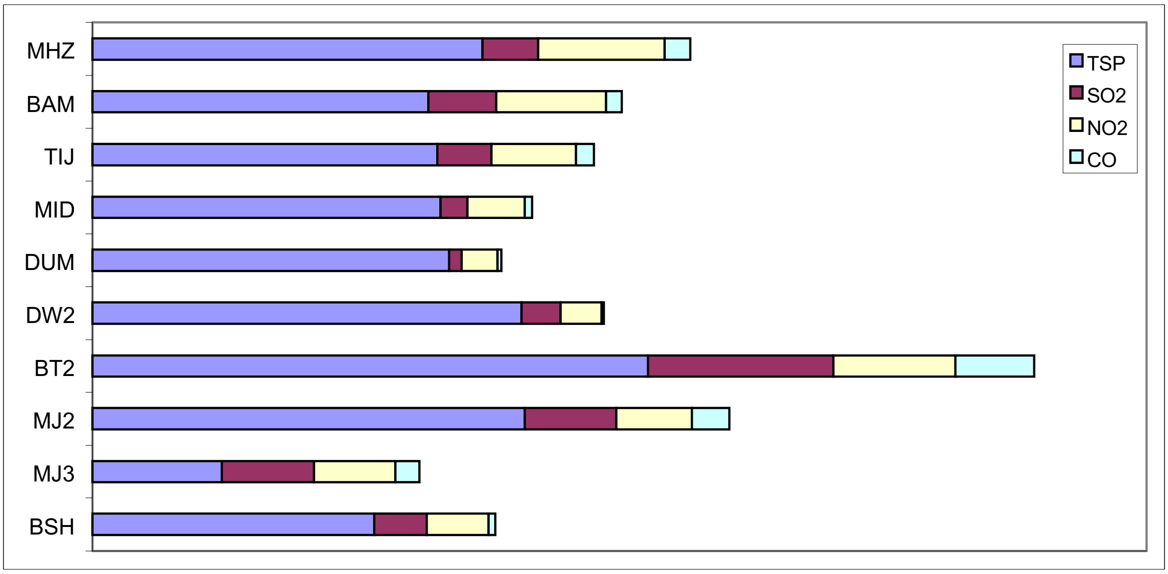


Figure 33: Summed pollutant concentration at each monitoring site.

As it can be seen in figure 33 the monitoring site BT2 was identified as the most polluted one. The following were MJ3 and the ‘traffic sites’ MHZ and BAM.

- It is difficult to compare the air monitoring results of Damascus with the results obtained in other cities, especially in different geographic regions. Nevertheless, such a comparison can be useful to classify the local pollution on an international level.

- Because no comparable air quality data of cities in the same geographic region was available, the data of European and South-American cities was used. The average concentrations of TSP, SO_2, NO_2 and CO from 5 foreign cities are compared with the results of Damascus in figure 34.

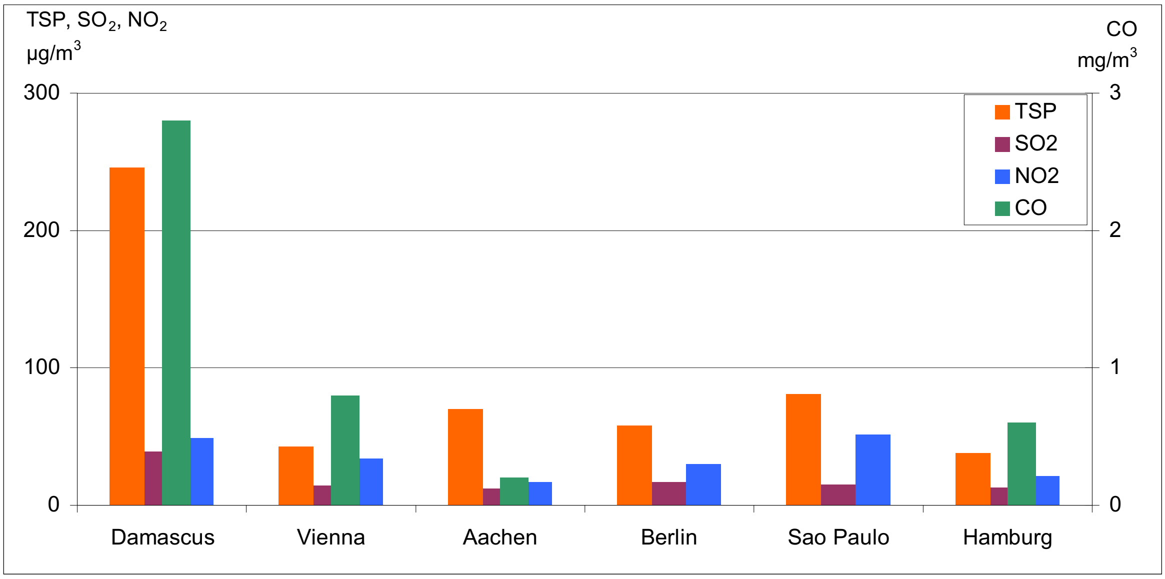


Figure 34: TSP, SO_2, NO_2 and CO in Damascus, Vienna (1995), Aachen (1999), Berlin (1996), São Paulo (1999) and Hamburg (1995) (source: [20], [21], [22], [23], [24]).

The average concentration of TSP is 3 to 6 times higher in Damascus than in the other cities. The specific geographical and climatic conditions in Damascus contribute to this high level.

Main factors for the high level of CO and SO_2 concentrations in Damascus in comparison to the concentrations in other cities are the uncontrolled emissions of fuel combustion and the quality of fuel used.

Concerning NO_2, the obtained results in Damascus correspond to the concentrations in other big cities.

5 Recommendations

During the described pilot air quality monitoring, high concentrations of air pollutants were recorded in various areas of Damascus. Even if international air quality standards were not exceeded, the level of pollution is comparably high. In order to maintain or regain a quality of ambient air that protects human health and welfare it is necessary to implement a suitable air quality management system which includes an adequate air monitoring programme as well as a catalogue of measures to reduce or avoid emissions.

A further air quality monitoring is needed not only to register the future trends of air pollution, but also as a tool for the definition and development of measures for the reduction and avoidance of emissions and , last but not least, to control the efficiency of implemented emission control measures. In detail, the air quality programme should focus on the following points:

- Continuation of the current air quality monitoring with the Mobile Unit, in order to complete the already sampled air quality data, by extending the monitoring period to the wintertime (heating period). Considering the results of the terminated pilot monitoring programme, the further monitoring should be at the monitoring site BT2 at Bab Tuma square, as the highest; MHZ in the city centre, as a traffic related monitoring site; TIJ (Tijara), BSH (Bab Sharki), MJ3 (Muhajrin), DW2 (Dwella) and MID (Midan), as residential areas; DUM in Dummar as the reference area.

- For the long-term air quality monitoring in Damascus the implementation of an air quality monitoring network is recommended. This network should consist of a number of stationary monitoring units. The location of these units should be in areas of high pollution as well as residential, commercial and industrial areas. Considering the build-up of a necessary infra-structure and the financing of such a network, the installation should be established step-by-step. The first monitoring stations should be installed in the eastern part of the old city, in an area of strong traffic influence (p. ex.: Yousef Al Azmeh square or Baramikeh), and in a residential area like Midan, Tijara, Muhajrin or Dwella.

- The future long-term air quality monitoring should register long-term values like monthly or annual average concentrations, but also short-term values (1-hour or 30-minute-average concentrations), in order to identify crucial short-time pollution episodes and to develop suitable measures to reduce or avoid such situations. To obtain such different types of air quality data, the network stations are to be equipped with automatic continuously measuring analysers which will be controlled by a computer system for the registration and evaluation of air quality data.

- The pilot air quality monitoring programme for Damascus included the measurement of the concentration of all particles in air. Concerning the health effects, the most critical part of the suspended particles is the fraction of particles with diameters less than 10 µm (PM_{10}), because they can enter the human respiratory organs. Therefore, the future monitoring should include the monitoring of those fine particles in air.

- In order to estimate the effects of particles it is necessary to get more information about the ingredients of suspended particles. Therefore, studies about the particle components should be undertaken. Filters of TSP sampling can be analysed in certain intervals (month, half-year or similar) and low volume samplers can be used to sample the particles over longer periods. The first analysis of components should cover a wide range of pollutants (metals, minerals, organics) to identify the main ingredients which should be analysed later on.

- The current air quality monitoring in Damascus includes the determination of the concentration of TSP, SO_2, NO_2 and CO. The future monitoring network should extend the monitoring to hydrocarbons, which are presumably emitted in considerable ranges by the high number of uncontrolled firings of fossil fuels. The hydrocarbon monitoring can be the measuring of the total hydrocarbon content in ambient air using automatic analysers, or the measurement of specific hydrocarbons (p. ex. benzene, polycyclic aromatics) using gas-sampling devices and laboratory analysis.

- Although some spot measurements of ozone in Syria gave low concentrations, it is recommended to include ozone monitoring in the monitoring network at one station in the periphery of the city (p. ex. Dummar, Mezzah).

- As the results of the pilot air quality monitoring in the traffic influenced monitoring sites showed, the main part of particles sampled at those sites were fine and black particles which were predominately emitted as soot from diesel fuelled vehicles. Considering the serious effects of soot on health, it is necessary to integrate soot monitoring in the future air quality monitoring programme in monitoring sites influenced by traffic.

- In order to cover all mentioned aspects and extensions of a future air quality management system and to establish a consistent concept, the elaboration of an ‘Air Quality Management Concept’ is recommended. This concept should include:
    - monitoring sites, pollutants, periods and frequency
    - registration, processing and evaluation of data
    - infra-structure and organisation for operation of the network
    - build-up of the monitoring network (technical, financial, organisational).

An air quality monitoring programme can support the identification of air pollution problems and the development of measures to reduce air pollution and to improve the ambient air quality. But in order to improve the air quality, measures to reduce emission and to promote the dilution or decomposition of pollutants have to be developed and implemented.

Based on the results presented in the emission inventory and the pilot air quality monitoring and considering the information of former air quality studies, the following basic measures are recommended:

– Before suitable measures to reduce or avoid emission and to improve air quality can be developed, the goals of air quality management have to be defined. Technically these goals will be expressed in air quality and emission standards which have to be to obeyed. The establishment of such standards should consider international experiences and local conditions and requirements. Because air quality management is connected to several areas, such as transport, energy, planning, development and the environment, these sectors should be involved in the process of defining goals and standards.

– In order to reduce the air pollution generated by vehicle traffic, which was identified as the main contributor to air pollution in Damascus, measures to reduce traffic caused emissions should include:
  - improvement of fuel quality, p. ex. reducing the sulphur content in diesel fuel
  - regularly control of vehicle emission by measurement of every vehicle
  - promotion of the use of catalyst vehicles, p. ex. financial appeals.

– The public transport sector in Damascus is based on so-called "mini busses", which are the primary source of transport caused air pollution in Damascus especially during the rush hour in the morning and the evening. In order to reduce the emission from this sector a suitable public transport concept is necessary. This concept should include an adequate network of lines, running intervals, decentralisation of traffic, extension of electric trains, trams etc. for regional transport.

– The possibility of reducing urban traffic by excluding vehicles from certain areas should be studied. For example, the old city of Damascus is characterised by small and narrow streets and ancient architecture, which constrains the dispersion and dilution of pollution generated. Therefore, the air pollution caused by vehicles and household heating in the old city stays inside the small streets for a long time. A reduction or avoidance of traffic in this part of Damascus would greatly improve the air quality.

– In order to reduce the emissions by fuel combustion in households, commerce and industry, the implementation of modern combustion technologies for ovens and furnaces should be promoted.

– The promotion of the use of regenerative energies (p. ex.: sun energy) for domestic and commercial use instead of fossil fuels can contribute to the reduction of fuel combustion based emission.

- As the measurement of wind parameters in the different monitoring sites showed, the wind velocity inside the town was less than in the surroundings. High wind speeds contribute to the dispersion of pollutants, therefore, a promotion of better wind fields should be considered in urban planning. For example, green areas as “cooling islands”, can provoke an increasing turbulence; the planning of new building areas should consider the integration of green areas and wind “canyons” to improve the inner-urban wind flow.

- All the mentioned measures need to be accompanied by programmes of public awareness and environmental education, in order to generate public consciousness of environmental, especially air quality problems and their solutions. Everybody contributes to air pollution and everybody can reduce his or her contribution, p. ex.: switch off the car while parking, use less fuel consuming vehicles, use modern heating technologies.

- A detailed catalogue of suitable measures of emission reduction should be elaborated in co-operation of representatives of all involved areas, transport, planning, energy, meteorology, research and environment, and should consider international experiences and standards.

The above mentioned recommendations will be detailed and structured in an air quality monitoring programme for Damascus.

References

[1] Syrian High Commission for Environmental Affairs. Proposal of Syria n Standards for Air Pollutants (atmosphere)”. Damascus 1993.

[2] World Health Organisation. Guidelines for Air Quality. Geneva 1999.

[3] Federal Ministry for Environment, Nature Conservation and Rector Safety. Technical Instructions on Air Quality Control. (Technische Anleitung zur Reinhaltung der Luft, TA Luft). Bonn 1986.

[4] 22nd Ordinance for the execution of the Federal Immssion Control Act. Ordinance about air quality standards (22. BImSchV) of 26. October 1993 (BGBl. I S. 1819).

[5] 23rd Ordinance for the execution of the Federal Immssion Control Act. Ordinance about the definition of air quality standards (23. BImSchV) of 16. December 1996 (BGBl. I S. 1962).

[6] European Union. Directive 1999/30/EG of 22. April 1999 about concentrations of sulphur dioxide, nitrogen dioxide and nitrogen oxides, particles and lead in air.

[7] Governorate of Damascus. Survey 1996.

[8] Syrian Arab Republic, Office of the Prime Minister, Central Bureau of Statistics: Statistical Abstract 1997, Fifty Year, Damascus 1997.

[9] Syrian Norm 68/1992. Diesel.

[10] Syrian Norm 152/1992. Super gasoline.

[11] Syrian Norm 153/1992. Normal gasoline.

[12] ESRC. Summary of Country Study on Climate Changes due to greenhouse gases. Damascus 1999.

[13] Sadkop information.

[14] Umweltbundesamt. Ermittlung der mittleren Emissionsfaktoren zur Darstellung der Emissionsentwicklung aus Feuerungsanlagen im Bereich der Haushalte und Kleinverbraucher. Texte 14/00. Berlin 2000.

[15] United Nations Environment Programme (UNEP), Organisation for Economi c Co-operation and Development (OECD), International Energy Agency (IEA), Intergovernmental Panel on Climate Change (IPCC). Greenhouse Gas Inventory. IPCC Guidelines for National Gree n-house Gas Inventories. London 1995.

[16] US Environmental Protection Age ncy. Factor Information Retrieval Data System (Fire 6.21). 1999.

[17] Boubel, Richard W. et al. Fundamentals of Air Pollution. Academic Press. San Diego 1994.

[18] Ministry of Defence, Meteorological Department, Damascus. Monthly averages and e x-tremes 1956-1997. Damascus New Airport.

[19] Syrian Atomic Energy Commission. Study of particulates and heavy elements in air of some Syrian cities. Final report on scientific research. Damascus 1999.

[20] Freie und Hansestadt Hamburg. Luftreinhaltung in Hamburg 1982 bis 2000. Hamburg 1997.

[21] Stadt Aachen. Umweltbericht 1999 – Luft. Aachen, 2000.

[22] Umweltbundesamt. Environmental Data Germany 1998. Berlin, 1999.

[23] Magistrat der Stadt Wien. Wiener Umwelt -Bericht. Beiträge zum Umweltschutz 1995. Heft 36. Wien, 1996.

[24] Companhia de Tecnologia de Saneamento Ambiental. Relatório da Qualidade do Ar no Estado de São Paulo 1999. São Paulo, 2000.

Glossary

BAM	Monitoring site in Damascus (see figure 16): Baramikeh
BGBL	Bundes-Gesetzblatt. Official Diary for publication of Germa legislation
BImSchG	Bundes-Immissionsschutzgesetz. German Federal Immission Control Act. German Air Quality Law.
BImSchG	Bundes-Immissionsschutzverordnung. German Ordinances for the realisation of the BImSchG
BSH	Monitoring site in Damascus (see figure 16): Bab Sharki
BT	Monitoring site in Damascus (see figure 16): BT1- Maktab Ambar Office; BT2 – Bab Tuma square
DW	Monitoring site in Damascus (see figure 16): DW1- Dwella Hospital; DWT2 – Jramana, Ibrahim Al-Khalil Convent
DUM	Monitoring site in Damascus (see figure 16): Mashro Dummar
EPA	Environmental Protection Agency of the United States of America
ESRC	Environmental & Scientific Research Centre of the Syrian Arab Republic
EWG	Europäische Wirtschaftsgemeinschaft
	former name of the EU
EU	European Union
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH; German Society for technical cooperation
HVS	High-Volume-Sampler for TSP monitoring
IEA	International Energy Agency
ILO	International Labour Organisation
IPCC	International Panel on Climate Change
JO	Monitoring site in Damascus (see figure 16): JO1- in Jobar at the Al Djihad School; JO2 – in Jobar-Tiba
MID	Monitoring site in Damascus (see figure 16): Midan
MJ	Monitoring site in Damascus (see figure 16): MJ1- in Muhajrin, Salahaddin Al-Ayoubi School; MJ2 – in Muhajrin, at cemetery; MJ3 – in muhajrin at Khorshid square
MHZ	Monitoring site in Damascus (see figure 16): Yousef Al-Azmeh square
OECD	Organisation for Economic Co-operation and Development
PM10	Particulate Matter with diameter less than 10 µm
TA Luft	German Technical Instructions on Air Quality Control.
TCM	Tetrachloromercurate, a chemical substance for analysis
TIJ	Monitoring site in Damascus (see figure 16): Tijara
TSP	Total Suspended Particulates
	all particles suspended in ambient air
UNEP	United Nations Environmental Programme
WHO	World Health Organisation
a	ano; year
ha	hectare (= 10000 m^2)
l	litre
l/a	litre per year
kg/l	kilogram per l (density)
kt/a	kilo tons per year
t/a	tons per year
mg	milligram (1000^{th} gram = 0.001 g = 10^{-3} g)
µg	microgram (1000000^{th} gram = 0.000001 g = 10-6 g)
mg/m^3	milligram per cubic meter (concentration)
m/s	meter per second (velocity)
$µg/m^3$	microgram per cubic meter (concentration)
µm	micrometer (1000000^{th} meter = 0.000001 m = 10^{-6} m)

Annex

Table A: 1-h average concentrations at monitoring site MHZ.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
16.05.00	10:00	63	79	147	4.7	18.05.00	01:00	36	70	95	4.1
16.05.00	11:00	58	77	131	4.9	18.05.00	02:00	52	86	118	4.2
16.05.00	12:00	53	83	103	5.1	18.05.00	03:00	33	47	71	2.4
16.05.00	01:00	70	93	112	5.3	18.05.00	04:00	25	41	66	2.3
16.05.00	02:00	83	125	141	4.9	18.05.00	05:00	25	45	68	2.7
16.05.00	05:00	172	93	73	3.6	18.05.00	06:00	24	60	73	3.3
16.05.00	06:00	11	58	80	4.4	18.05.00	07:00	24	71	80	4.1
16.05.00	07:00	19	65	89	5.2	18.05.00	08:00	30	93	88	4.6
16.05.00	08:00	20	74	90	5.0	18.05.00	09:00	36	107	95	4.6
16.05.00	09:00	18	58	66	4.3	18.05.00	10:00	23	54	67	2.8
16.05.00	10:00	15	43	74	3.5	18.05.00	11:00	13	30	49	2.0
16.05.00	11:00	10	24	56	3.1	19.05.00	00:00	9	21	49	1.7
17.05.00	00:00	5	22	54	2.9	19.05.00	01:00	5	13	34	1.4
17.05.00	01:00	5	14	40	2.4	19.05.00	02:00	4	10	24	1.3
17.05.00	02:00	15	15	43	2.4	19.05.00	03:00	3	10	19	1.2
17.05.00	03:00	9	6	29	2.2	19.05.00	04:00	4	9	16	1.1
17.05.00	04:00	5	6	20	2.1	19.05.00	05:00	6	8	18	1.1
17.05.00	05:00	10	8	38	2.1	19.05.00	06:00	5	5	21	1.0
17.05.00	06:00	22	14	33	2.1	19.05.00	07:00	8	12	21	1.0
17.05.00	07:00	33	41	54	2.7	19.05.00	08:00	14	13	26	1.1
17.05.00	08:00	53	91	89	4.2	19.05.00	09:00	15	18	26	1.2
17.05.00	09:00	41	93	91	5.5	19.05.00	10:00	17	28	36	1.3
17.05.00	10:00	36	89	77	5.7	19.05.00	11:00	15	22	33	1.4
17.05.00	11:00	33	78	75	5.2	19.05.00	12:00	13	22	32	1.5
17.05.00	12:00	34	80	71	9.1	19.05.00	01:00	15	24	38	1.6
17.05.00	01:00	40	95	82	5.7	19.05.00	02:00	18	26	40	1.8
17.05.00	02:00	89	119	96	4.5	19.05.00	03:00	16	20	38	1.5
17.05.00	03:00	40	48	64	2.3	19.05.00	04:00	13	20	33	1.5
17.05.00	04:00	21	48	73	2.5	19.05.00	05:00	13	22	36	1.5
17.05.00	05:00	31	77	90	3.5	19.05.00	06:00	14	22	40	1.6
17.05.00	06:00	36	88	106	4.5	19.05.00	07:00	19	25	54	2.0
17.05.00	07:00	41	118	111	5.7	19.05.00	08:00	22	29	61	2.0
17.05.00	08:00	40	107	109	5.2	19.05.00	09:00	24	43	89	2.7
17.05.00	09:00	71	224	130	7.0	19.05.00	10:00	20	49	83	2.7
17.05.00	10:00	82	253	123	5.5	19.05.00	11:00	21	46	86	2.3
17.05.00	11:00	73	217	112	4.5	20.05.00	00:00	16	53	82	2.4
18.05.00	00:00	51	185	94	4.1	20.05.00	01:00	8	24	58	1.6
18.05.00	01:00	26	35	56	1.7	20.05.00	02:00	3	21	60	1.3
18.05.00	02:00	6	14	37	1.3	20.05.00	03:00	2	15	47	1.3
18.05.00	03:00	9	6	27	1.1	20.05.00	04:00	1	12	48	1.1
18.05.00	04:00	12	24	42	1.4	20.05.00	05:00	3	2	34	0.9
18.05.00	05:00	11	13	40	1.2	20.05.00	06:00	24	26	59	1.1
18.05.00	06:00	47	46	72	1.4	20.05.00	07:00	35	47	72	1.5
18.05.00	07:00	55	48	79	1.6	20.05.00	08:00	39	34	62	1.8
18.05.00	08:00	59	80	87	3.0	20.05.00	09:00	39	44	68	2.8
18.05.00	09:00	57	95	88	4.0	20.05.00	10:00	31	44	64	2.9
18.05.00	10:00	68	122	125	6.3	20.05.00	11:00	32	51	69	3.6
18.05.00	11:00	56	95	109	5.4	20.05.00	12:00	25	38	61	2.9
18.05.00	12:00	43	69	112	4.3	20.05.00	01:00	28	38	69	2.7

Table A: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
20.05.00	02:00	57	103	147	4.6	22.05.00	03:00	29	32	67	2.1
20.05.00	03:00	36	52	104	2.9	22.05.00	04:00	44	50	84	2.3
20.05.00	04:00	33	42	84	2.5	22.05.00	05:00	55	71	125	3.2
20.05.00	05:00	35	66	103	3.6	22.05.00	06:00	46	67	135	4.3
20.05.00	06:00	35	71	90	3.8	22.05.00	07:00	54	102	145	5.2
20.05.00	07:00	33	82	97	4.3	22.05.00	08:00	95	185	165	5.9
20.05.00	08:00	35	87	99	4.6	22.05.00	09:00	103	269	189	7.3
20.05.00	09:00	43	128	124	5.7	22.05.00	10:00	77	142	161	4.3
20.05.00	10:00	40	118	128	4.6	22.05.00	11:00	38	51	115	2.5
20.05.00	11:00	27	50	99	2.2						
21.05.00	00:00	17	17	73	1.7	25.06.00	00:00	16	40	97	2.9
21.05.00	01:00	15	17	76	1.6	25.06.00	01:00	30	17	81	1.1
21.05.00	02:00	17	26	78	1.7	25.06.00	02:00	20	16	68	0.7
21.05.00	03:00	15	23	68	1.4	25.06.00	03:00	2	8	38	0.3
21.05.00	04:00	12	15	64	1.1	25.06.00	04:00	2	5	31	0.2
21.05.00	05:00	35	21	68	1.2	25.06.00	05:00	24	6	50	0.3
21.05.00	06:00	33	43	82	1.4	25.06.00	06:00	27	29	68	1.0
21.05.00	07:00	72	60	84	1.7	25.06.00	07:00	64	62	87	2.0
21.05.00	08:00	72	82	89	2.3	25.06.00	08:00	97	125	141	5.3
21.05.00	09:00	49	66	72	3.3	25.06.00	09:00	103	134	180	8.9
21.05.00	10:00	20	32	45	2.4	25.06.00	10:00	84	62	143	7.8
21.05.00	11:00	26	34	53	2.4	25.06.00	11:00	52	57	121	7.6
21.05.00	12:00	35	49	92	3.2	25.06.00	12:00	33	70	98	7.3
21.05.00	01:00	34	40	72	2.8	25.06.00	01:00	33	57	100	5.5
21.05.00	02:00	42	45	92	2.9	25.06.00	02:00	44	82	105	7.0
21.05.00	03:00	30	40	89	2.5	25.06.00	03:00	20	40	73	3.1
21.05.00	04:00	49	47	103	2.8	25.06.00	04:00	18	32	66	2.3
21.05.00	05:00	50	67	123	3.2	25.06.00	05:00	19	38	70	3.1
21.05.00	06:00	79	144	166	5.1	25.06.00	06:00	13	33	69	3.3
21.05.00	07:00	87	176	148	6.0	25.06.00	07:00	13	36	68	3.7
21.05.00	08:00	92	166	148	5.5	25.06.00	08:00	12	40	69	4.1
21.05.00	09:00	73	173	153	5.7	25.06.00	09:00	17	58	82	5.3
21.05.00	10:00	55	96	120	3.5	25.06.00	10:00	14	45	91	4.2
21.05.00	11:00	27	38	87	2.0	25.06.00	11:00	5	24	62	2.1
22.05.00	00:00	27	30	85	2.3	26.06.00	00:00	2	12	40	1.1
22.05.00	01:00	14	19	71	1.7	26.06.00	01:00	0	6	23	0.5
22.05.00	02:00	32	19	80	1.5	26.06.00	02:00	0	3	20	0.2
22.05.00	03:00	30	31	85	1.7	26.06.00	03:00	10	1	31	0.1
22.05.00	04:00	41	84	90	1.9	26.06.00	04:00	38	5	57	0.1
22.05.00	05:00	37	41	78	1.5	26.06.00	05:00	59	11	60	0.3
22.05.00	06:00	67	80	86	1.5	26.06.00	06:00	44	38	72	0.9
22.05.00	07:00	102	119	116	2.4	26.06.00	07:00	73	96	105	2.9
22.05.00	08:00	84	59	99	2.6	26.06.00	08:00	112	143	153	6.4
22.05.00	09:00	56	47	85	3.0	26.06.00	09:00	110	115	180	8.8
22.05.00	10:00	33	31	67	3.0	26.06.00	10:00	86	81	136	8.9
22.05.00	11:00	59	59	103	3.7	26.06.00	11:00	46	29	87	4.2
22.05.00	12:00	49	52	88	3.5	26.06.00	12:00	43	64	99	5.9
22.05.00	01:00	60	98	138	3.8	26.06.00	01:00	46	92	111	7.4
22.05.00	02:00	47	51	90	2.7	26.06.00	02:00	40	56	128	6.0

Table A: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
26.06.00	03:00	27	30	87	3.0	28.06.00	04:00	28	27	68	2.9
26.06.00	04:00	25	34	90	3.2	28.06.00	05:00	14	10	44	1.1
26.06.00	05:00	28	41	90	4.5	28.06.00	06:00	36	59	98	5.2
26.06.00	06:00	25	43	84	5.9	28.06.00	07:00	35	82	115	10.6
26.06.00	07:00	22	40	91	5.4	28.06.00	08:00	37	68	119	6.4
26.06.00	08:00	19	41	88	5.0	28.06.00	09:00	40	80	130	8.3
26.06.00	09:00	15	40	73	4.5	28.06.00	10:00	42	113	112	7.6
26.06.00	10:00	14	46	85	4.5	28.06.00	11:00	39	65	91	4.1
26.06.00	11:00	13	36	91	3.6	29.06.00	00:00	26	50	79	2.7
27.06.00	00:00	27	47	96	2.5	29.06.00	01:00	29	28	79	1.9
27.06.00	01:00	7	33	72	2.1	29.06.00	02:00	16	9	56	1.0
27.06.00	02:00	30	14	68	0.8	29.06.00	03:00	12	8	39	0.6
27.06.00	03:00	21	14	65	0.4	29.06.00	04:00	10	6	33	0.2
27.06.00	04:00	7	3	28	0.0	29.06.00	05:00	13	12	42	0.5
27.06.00	05:00	7	2	25	0.0	29.06.00	06:00	38	49	60	1.2
27.06.00	06:00	18	17	47	0.4	29.06.00	07:00	64	50	94	2.0
27.06.00	07:00	64	59	80	2.5	29.06.00	08:00	91	72	117	3.8
27.06.00	08:00	104	92	113	5.1	29.06.00	09:00	51	44	80	3.4
27.06.00	09:00	43	76	118	7.6	29.06.00	10:00	33	34	66	4.0
27.06.00	10:00	83	76	138	8.0	29.06.00	11:00	57	34	74	4.3
27.06.00	11:00	54	54	113	6.7	29.06.00	12:00	36	40	81	4.1
27.06.00	12:00	31	30	77	4.3	29.06.00	01:00	41	52	90	4.2
27.06.00	01:00	44	53	109	6.6	29.06.00	02:00	58	102	118	7.4
27.06.00	02:00	71	138	156	9.8	29.06.00	03:00	41	41	83	3.7
27.06.00	03:00	28	39	84	3.5	29.06.00	04:00	28	35	69	2.6
27.06.00	04:00	26	32	83	3.1	29.06.00	05:00	36	64	106	4.6
27.06.00	05:00	25	42	86	4.3	29.06.00	06:00	39	95	124	6.4
27.06.00	06:00	20	48	88	4.9	29.06.00	07:00	47	124	121	7.0
27.06.00	07:00	25	59	103	6.6	29.06.00	08:00	70	222	110	10.4
27.06.00	08:00	22	58	84	5.9	29.06.00	09:00	52	139	109	8.0
27.06.00	09:00	15	32	72	3.8	29.06.00	10:00	29	77	89	4.8
27.06.00	10:00	7	24	58	2.3	29.06.00	11:00	30	61	84	3.1
27.06.00	11:00	3	19	53	1.7	30.06.00	00:00	46	79	83	3.5
28.06.00	00:00	0	10	41	1.1	30.06.00	01:00	24	91	84	4.0
28.06.00	01:00	10	10	57	1.1	30.06.00	02:00	36	111	81	3.9
28.06.00	02:00	26	15	70	1.0	30.06.00	03:00	16	51	69	2.0
28.06.00	03:00	27	12	64	0.3	30.06.00	04:00	22	41	65	1.5
28.06.00	04:00	6	2	24	0.0	30.06.00	05:00	22	24	57	0.9
28.06.00	05:00	5	2	21	0.1	30.06.00	06:00	47	72	64	1.5
28.06.00	06:00	9	14	34	0.7	30.06.00	07:00	43	57	75	1.3
28.06.00	07:00	27	43	59	2.2	30.06.00	08:00	37	23	74	1.1
28.06.00	08:00	62	95	100	5.7	30.06.00	09:00	46	15	87	1.4
28.06.00	09:00	73	93	143	8.6	30.06.00	10:00	29	14	72	1.5
28.06.00	10:00	53	58	131	8.0	30.06.00	11:00	24	12	50	1.4
28.06.00	11:00	50	57	112	6.2	30.06.00	12:00	18	10	46	1.1
28.06.00	12:00	43	52	106	6.3	30.06.00	01:00	22	13	53	1.3
28.06.00	01:00	39	69	111	6.5	30.06.00	02:00	24	13	51	1.7
28.06.00	02:00	48	71	106	5.9	30.06.00	03:00	26	10	48	1.1
28.06.00	03:00	33	39	87	3.8	30.06.00	04:00	23	7	43	0.8

Table A: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
30.06.00	05:00	27	23	75	2.3
30.06.00	06:00	25	23	80	2.2
30.06.00	07:00	27	27	82	2.8
30.06.00	08:00	26	39	101	3.8
30.06.00	09:00	48	74	122	4.5
30.06.00	10:00	57	94	129	5.6
30.06.00	11:00	31	56	89	3.9
01.07.00	00:00	30	25	80	1.9
01.07.00	01:00	21	20	77	1.7
01.07.00	02:00	37	83	90	3.3
01.07.00	03:00	33	64	85	3.0
01.07.00	04:00	30	21	69	1.0
01.07.00	05:00	51	39	74	1.1
01.07.00	06:00	76	86	83	1.7
01.07.00	07:00	102	130	120	2.9
01.07.00	08:00	140	121	159	6.1
01.07.00	09:00	203	134	236	8.7
01.07.00	10:00	82	41	144	5.0
01.07.00	11:00	62	26	106	4.4
01.07.00	12:00	44	26	84	4.1
01.07.00	01:00	58	33	130	5.3
01.07.00	02:00	102	118	212	9.7
01.07.00	03:00	54	53	106	4.8
01.07.00	08:00	41	98	130	9.5
01.07.00	09:00	41	86	128	8.4
01.07.00	10:00	47	95	116	6.2
01.07.00	11:00	27	77	99	5.0

Table B: 1-h average concentrations at monitoring site BAM.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
24.05.00	00:00	27	32	75	2.4	26.05.00	01:00	17	30	59	2.1
24.05.00	01:00	32	12	76	1.9	26.05.00	02:00	10	15	36	1.7
24.05.00	02:00	10	7	56	1.7	26.05.00	03:00	8	6	27	1.4
24.05.00	03:00	8	9	32	1.6	26.05.00	04:00	14	12	35	1.5
24.05.00	04:00	10	10	33	1.6	26.05.00	05:00	18	19	38	1.6
24.05.00	05:00	21	16	46	1.7	26.05.00	06:00	18	13	31	1.5
24.05.00	06:00	25	25	42	1.7	26.05.00	07:00	19	16	30	1.6
24.05.00	07:00	58	54	61	2.2	26.05.00	08:00	38	27	40	1.9
24.05.00	08:00	58	42	68	2.4	26.05.00	09:00	33	35	51	2.0
24.05.00	09:00	54	42	67	2.1	26.05.00	10:00	30	30	50	1.9
24.05.00	10:00	40	31	57	2.6	26.05.00	11:00	24	19	38	1.7
24.05.00	11:00	43	30	62	2.5	26.05.00	12:00	24	23	40	1.7
24.05.00	12:00	56	41	79	2.8	26.05.00	01:00	22	22	40	1.6
24.05.00	01:00	52	35	83	2.9	26.05.00	02:00	27	30	49	1.9
24.05.00	02:00	52	36	71	2.4	26.05.00	03:00	23	21	39	1.6
24.05.00	03:00	31	19	44	1.9	26.05.00	04:00	24	19	39	1.7
24.05.00	04:00	43	41	71	2.2	26.05.00	05:00	22	20	40	1.7
24.05.00	05:00	32	26	59	1.8	26.05.00	06:00	26	20	52	1.8
24.05.00	06:00	30	25	58	2.0	26.05.00	07:00	30	24	66	1.9
24.05.00	07:00	31	23	66	2.0	26.05.00	08:00	25	22	57	1.9
24.05.00	08:00	34	30	82	2.2	26.05.00	09:00	20	17	48	1.8
24.05.00	09:00	25	23	63	2.1	26.05.00	10:00	17	14	59	1.7
24.05.00	10:00	20	17	56	1.8	26.05.00	11:00	16	13	52	1.7
24.05.00	11:00	21	22	77	2.2	27.05.00	00:00	23	34	80	2.3
25.05.00	00:00	31	41	99	2.5	27.05.00	01:00	12	9	55	1.7
25.05.00	01:00	31	38	90	2.3	27.05.00	02:00	17	5	51	1.5
25.05.00	02:00	31	11	56	1.7	27.05.00	03:00	15	3	31	1.4
25.05.00	03:00	16	10	48	1.5	27.05.00	04:00	17	6	39	1.5
25.05.00	04:00	16	12	44	1.5	27.05.00	05:00	37	20	66	1.7
25.05.00	05:00	18	20	41	1.6	27.05.00	06:00	56	37	70	1.8
25.05.00	06:00	47	27	55	1.7	27.05.00	07:00	96	60	82	2.3
25.05.00	07:00	66	50	58	2.0	27.05.00	08:00	114	78	98	3.5
25.05.00	08:00	67	68	73	2.7	27.05.00	09:00	92	82	120	4.1
25.05.00	09:00	61	56	77	3.1	27.05.00	10:00	56	46	78	3.2
25.05.00	10:00	74	53	80	5.0	27.05.00	11:00	52	41	83	3.2
25.05.00	11:00	54	48	84	3.6	27.05.00	12:00	54	36	75	3.0
25.05.00	12:00	47	49	70	2.8	27.05.00	01:00	50	39	80	3.2
25.05.00	01:00	50	47	66	2.9	27.05.00	02:00	49	31	89	2.8
25.05.00	02:00	52	50	68	2.7	27.05.00	03:00	47	34	81	2.5
25.05.00	03:00	50	51	66	2.2	27.05.00	05:00	44	30	79	2.1
25.05.00	04:00	39	40	48	1.9	27.05.00	06:00	65	64	124	2.6
25.05.00	05:00	49	56	70	2.1	27.05.00	07:00	68	63	114	2.9
25.05.00	06:00	38	41	58	2.1	27.05.00	08:00	63	24	101	0.9
25.05.00	07:00	44	38	67	2.2	27.05.00	09:00	92	51	123	1.9
25.05.00	08:00	45	44	75	2.3	27.05.00	10:00	50	42	110	1.9
25.05.00	09:00	48	58	69	2.6	27.05.00	11:00	46	34	103	1.1
25.05.00	10:00	62	85	90	3.2	28.05.00	00:00	39	15	75	0.7
25.05.00	11:00	51	84	86	2.9	28.05.00	01:00	23	7	65	0.3
26.05.00	00:00	18	17	55	2.0	28.05.00	02:00	28	13	65	0.3

Table B: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
28.05.00	03:00	10	1	36	0.0	30.05.00	04:00	28	31	69	0.5
28.05.00	04:00	18	7	48	0.1	30.05.00	05:00	70	100	84	1.0
28.05.00	05:00	51	70	81	0.5	30.05.00	06:00	65	66	75	0.6
28.05.00	06:00	86	90	81	0.8	30.05.00	07:00	130	156	119	1.9
28.05.00	07:00	89	75	97	0.8	30.05.00	08:00	124	112	157	2.7
28.05.00	08:00	89	66	109	1.5	30.05.00	09:00	82	52	108	2.0
28.05.00	09:00	67	60	81	1.8	30.05.00	10:00	47	33	64	1.3
28.05.00	10:00	52	42	78	1.6	30.05.00	11:00	44	38	71	1.6
28.05.00	11:00	40	23	63	1.1	30.05.00	12:00	39	31	66	1.4
28.05.00	12:00	51	28	67	1.3	30.05.00	01:00	33	24	51	0.7
28.05.00	01:00	34	21	48	0.8	30.05.00	02:00	43	37	73	1.1
28.05.00	02:00	32	22	57	0.6	30.05.00	03:00	42	36	57	0.5
28.05.00	03:00	34	23	51	0.6	30.05.00	04:00	34	27	66	0.7
28.05.00	04:00	31	18	62	0.4	30.05.00	05:00	44	36	88	0.7
28.05.00	05:00	38	28	80	0.8	30.05.00	06:00	52	37	115	1.3
28.05.00	06:00	34	23	81	0.7	30.05.00	07:00	64	69	122	1.4
28.05.00	07:00	42	38	99	1.1	30.05.00	08:00	79	107	138	2.1
28.05.00	08:00	48	56	114	1.3	30.05.00	09:00	63	87	116	1.7
28.05.00	09:00	48	52	115	1.3	30.05.00	10:00	80	136	112	2.4
28.05.00	10:00	39	42	101	1.4	30.05.00	11:00	49	78	101	1.9
28.05.00	11:00	30	32	91	1.0						
29.05.00	00:00	22	25	77	0.6	03.07.00	00:00	19	51	86	2.1
29.05.00	01:00	23	19	72	0.4	03.07.00	01:00	38	111	106	3.6
29.05.00	02:00	24	15	73	0.2	03.07.00	02:00	57	234	109	6.0
29.05.00	03:00	36	8	62	0.0	03.07.00	03:00	64	191	98	5.2
29.05.00	04:00	38	12	59	0.1	03.07.00	04:00	71	163	89	3.7
29.05.00	05:00	52	45	79	0.4	03.07.00	05:00	88	170	96	3.3
29.05.00	06:00	87	100	97	0.9	03.07.00	06:00	120	148	109	3.3
29.05.00	07:00	93	71	95	1.0	03.07.00	07:00	69	79	88	1.9
29.05.00	08:00	92	81	104	1.6	03.07.00	08:00	69	86	109	3.3
29.05.00	09:00	78	59	99	1.9	03.07.00	09:00	97	80	136	5.1
29.05.00	10:00	63	41	89	1.5	03.07.00	10:00	107	49	158	6.0
29.05.00	11:00	49	40	90	1.6	03.07.00	11:00	96	28	160	6.0
29.05.00	12:00	44	40	64	1.6	03.07.00	12:00	63	20	108	4.1
29.05.00	01:00	47	42	78	1.6	03.07.00	01:00	48			2.7
29.05.00	02:00	45	34	75	1.3	03.07.00	02:00	41			2.0
29.05.00	03:00	41	27	60	0.7	03.07.00	08:00	75	39	106	3.2
29.05.00	04:00	37	26	61	0.6	03.07.00	09:00	16	38	95	2.4
29.05.00	05:00	36	26	71	0.5	03.07.00	10:00	10	28	81	1.8
29.05.00	06:00	45	31	102	1.1	03.07.00	11:00	7	31	76	1.7
29.05.00	07:00	46	28	126	1.2	04.07.00	00:00	3	17	55	0.8
29.05.00	08:00	40	36	112	1.1	04.07.00	01:00	2	15	46	0.8
29.05.00	09:00	36	40	93	1.1	04.07.00	02:00	0	11	33	0.3
29.05.00	10:00	44	58	97	1.7	04.07.00	03:00	0	5	27	0.0
29.05.00	11:00	45	67	95	1.2	04.07.00	04:00	3	10	40	0.0
30.05.00	00:00	35	43	84	0.9	04.07.00	05:00	16	26	60	0.6
30.05.00	01:00	26	34	88	0.9	04.07.00	06:00	45	53	63	1.4
30.05.00	02:00	42	24	78	0.5	04.07.00	07:00	53	53	75	1.3
30.05.00	03:00	34	46	82	0.7	04.07.00	08:00	106	84	135	3.9

Table B: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO2 µg/m³	CO mg/m³
04.07.00	09:00	115	71	158	4.9	07.07.00	04:00	19			1.2
04.07.00	10:00	94	46	161	4.8	07.07.00	05:00	26			0.9
04.07.00	11:00	53	32	98	2.6	07.07.00	06:00	18			1.0
04.07.00	12:00	42	44	72	3.3	07.07.00	07:00	27			1.5
04.07.00	01:00	44	48	90	2.7	07.07.00	08:00	73	42	113	1.9
04.07.00	02:00	37	40	82	1.7	07.07.00	09:00	34	23	101	1.6
04.07.00	03:00	28	30	56	1.0	07.07.00	10:00	28	33	106	1.7
04.07.00	04:00	29	33	61	0.9	07.07.00	11:00	16	19	83	1.5
04.07.00	05:00	30	34	76	0.8	08.07.00	12:00	56	24	75	2.7
04.07.00	06:00	24	23	74	1.2	08.07.00	01:00	28	22	71	2.3
04.07.00	07:00	26	30	97	1.5	08.07.00	02:00	31			2.4
04.07.00	08:00	11	18	59	0.8	08.07.00	03:00	36			2.3
04.07.00	09:00	17	28	81	1.4	08.07.00	07:00	29			2.4
04.07.00	10:00	12	25	75	1.2	08.07.00	08:00	155			2.3
04.07.00	11:00	8	14	68	1.0	08.07.00	09:00	30	23	99	2.6
05.07.00	00:00	5	9	59	0.7	08.07.00	10:00	32	56	122	3.0
05.07.00	01:00	0	5	26	0.0	08.07.00	11:00	11	14	70	1.2
05.07.00	02:00	0	5	23	0.0	09.07.00	00:00	28	57	103	3.2
05.07.00	03:00	0	2	9	0.0	09.07.00	01:00	10	24	78	1.7
05.07.00	04:00	1	4	18	0.0	09.07.00	02:00	7	25	63	1.0
05.07.00	05:00	10	9	32	0.0	09.07.00	03:00	20	21	86	1.3
05.07.00	06:00	50	35	72	0.7	09.07.00	04:00	12	13	62	0.8
05.07.00	07:00	72	50	78	1.8	09.07.00	05:00	72	95	92	1.5
05.07.00	08:00	121	115	140	5.4	09.07.00	06:00	87	120	95	1.6
05.07.00	09:00	101	96	174	6.4	09.07.00	07:00	60	64	100	0.9
05.07.00	10:00	57	40	104	3.9	09.07.00	08:00	67	70	109	2.5
05.07.00	11:00	44	37	76	3.9	09.07.00	09:00	47	39	82	2.4
05.07.00	12:00	42	35	87	3.5	09.07.00	10:00	56	30	75	2.6
06.07.00	11:00	56	36	105	5.3	09.07.00	11:00	36	24	60	2.4
06.07.00	12:00	52	42	96	5.7	09.07.00	08:00	99	24	68	1.2
06.07.00	01:00	38	33	86	3.2	09.07.00	09:00	5	17	55	1.1
06.07.00	10:00	9	62	132	3.3	09.07.00	10:00	5	14	49	1.0
06.07.00	11:00	13	31	104	2.5	09.07.00	11:00	0	8	33	0.5
07.07.00	12:00	29	73	113	3.8						
07.07.00	01:00	39	104	107	4.7	14.08.00	00:00	17	24	53	1.7
07.07.00	02:00	34	111	106	4.6	14.08.00	01:00	10	7	34	0.6
07.07.00	03:00	40	153	102	5.6	14.08.00	02:00	8	6	25	0.4
07.07.00	04:00	15	42	79	2.1	14.08.00	03:00	5	6	21	0.2
07.07.00	05:00	28	54	84	1.5	14.08.00	04:00	10	22	32	0.8
07.07.00	06:00	59	88	112	3.1	14.08.00	05:00	11	11	30	0.1
07.07.00	07:00	62	86	110	2.4	14.08.00	06:00	30	31	47	0.7
07.07.00	08:00	35	26	78	1.4	14.08.00	07:00	59	60	56	1.9
07.07.00	09:00	53	17	101	2.1	14.08.00	08:00	92	59	67	2.5
07.07.00	10:00	50	10	100	2.2	14.08.00	09:00	105	38	85	3.0
07.07.00	11:00	35	15	74	1.7	14.08.00	10:00	110	42	118	5.4
07.07.00	00:00	25	19	52	1.3	14.08.00	11:00	74	27	86	4.7
07.07.00	01:00	18			1.0	14.08.00	12:00	62	26	61	3.8
07.07.00	02:00	25			1.5	14.08.00	01:00	56	25	65	3.4
07.07.00	03:00	18			0.8	14.08.00	02:00	54	22	69	2.1

Table B: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
14.08.00	03:00	52	22	55	1.2	16.08.00	04:00	53			1.8
14.08.00	04:00	59	25	71	1.5	16.08.00	05:00	57			1.7
14.08.00	05:00	54	38	77	1.2	16.08.00	06:00	54			2.6
14.08.00	06:00	60	41	78	1.9	16.08.00	07:00	59	51	101	3.3
14.08.00	07:00	64	48	105	2.6	16.08.00	08:00	83	73	112	5.2
14.08.00	08:00	68	55	108	3.3	16.08.00	09:00	111	133	119	9.5
14.08.00	09:00	57	45	102	3.0	16.08.00	10:00	141	174	115	8.4
14.08.00	10:00	69	75	106	4.1	16.08.00	11:00	66	72	94	3.7
14.08.00	11:00	58	45	81	3.1	17.08.00	12:00	57	47	60	2.5
15.08.00	00:00	53	67	82	3.1	17.08.00	01:00	15	8	29	0.6
15.08.00	01:00	64	123	95	4.6	17.08.00	02:00	9	7	20	0.2
15.08.00	02:00	47	114	79	3.7	17.08.00	03:00	9	12	25	0.4
15.08.00	03:00	36	58	68	2.1	17.08.00	04:00	9	11	20	0.2
15.08.00	04:00	22	22	55	0.8	17.08.00	05:00	10	8	18	0.0
15.08.00	05:00	58	75	65	1.7	17.08.00	06:00	18	25	30	0.4
15.08.00	06:00	122	121	73	2.0	17.08.00	07:00	36	27	36	0.7
15.08.00	07:00	193	218	101	3.9	17.08.00	08:00	60	43	46	2.1
15.08.00	08:00	136	122	112	3.6	17.08.00	09:00	66	37	45	2.9
15.08.00	09:00	134	92	157	5.9	17.08.00	10:00	49	25	47	2.2
15.08.00	10:00	89	51	102	4.9	18.08.00	08:00	74	44	111	2.3
15.08.00	11:00	83	56	85	6.1	18.08.00	09:00	47	40	95	2.6
15.08.00	12:00	64	38	85	4.8	18.08.00	10:00	62	57	92	3.2
15.08.00	01:00	61	43	79	4.9	18.08.00	11:00	53	67	83	3.6
15.08.00	02:00	50	38	72	3.1	19.08.00	00:00	52	67	77	3.1
15.08.00	03:00	49			2.5	19.08.00	01:00	27	27	67	1.6
15.08.00	04:00	51			1.9	19.08.00	02:00	17	16	52	1.0
15.08.00	05:00	52			3.0	19.08.00	03:00	15	7	46	0.4
15.08.00	06:00	65			5.1	19.08.00	04:00	14	10	44	0.2
15.08.00	07:00	133			8.2	19.08.00	05:00	22	14	35	0.4
15.08.00	08:00	125	155	134	8.9	19.08.00	06:00	26	22	32	0.4
15.08.00	09:00	149	223	140	12.5	19.08.00	07:00	51	38	47	0.9
15.08.00	10:00	96	109	105	6.2	19.08.00	08:00	59	40	49	2.3
15.08.00	11:00	25	18	43	1.3	19.08.00	09:00	56	39	56	2.7
16.08.00	00:00	18	17	34	1.1	19.08.00	10:00	70	34	64	4.1
16.08.00	01:00	12	10	31	0.8	19.08.00	11:00	74	42	75	3.8
16.08.00	02:00	9	6	20	0.4	19.08.00	12:00	69	44	82	5.9
16.08.00	03:00	8	6	20	0.2	19.08.00	01:00	69	43	92	4.5
16.08.00	04:00	5	3	16	0.1	19.08.00	02:00	56	38	66	2.5
16.08.00	05:00	12	9	28	0.3	19.08.00	03:00	47	35	63	1.9
16.08.00	06:00	33	26	43	0.8	19.08.00	04:00	46	30	55	1.3
16.08.00	07:00	62	51	55	1.7	19.08.00	05:00	46	36	66	1.6
16.08.00	08:00	72	42	65	2.0	19.08.00	06:00	52	27	86	2.4
16.08.00	09:00	82	37	97	3.4	19.08.00	07:00	45	31	85	2.0
16.08.00	10:00	106	37	140	6.4	19.08.00	08:00	42	28	83	1.6
16.08.00	11:00	84	27	102	4.8	19.08.00	09:00	29	21	66	1.4
16.08.00	12:00	72	36	90	4.8	19.08.00	10:00	30	31	69	1.9
16.08.00	01:00	69	38	88	4.9	19.08.00	11:00	39	47	89	2.4
16.08.00	02:00	65	46	69	3.3	20.08.00	00:00	27	28	71	1.7
16.08.00	03:00	47			1.8	20.08.00	01:00	12	11	35	0.5

Table B: continued

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
20.08.00	02:00	8	7	31	0.3
20.08.00	03:00	12	13	36	0.3
20.08.00	04:00	23	14	41	0.2
20.08.00	05:00	20	17	31	0.3
20.08.00	06:00	27	21	39	0.4
20.08.00	07:00	49	39	52	1.1
20.08.00	08:00	76	51	72	2.1
20.08.00	09:00	91	44	84	3.0
20.08.00	10:00	103	42	89	3.8
20.08.00	11:00	66	29	74	4.8
20.08.00	12:00	54	26	60	4.4
20.08.00	01:00	50	23	66	2.5
20.08.00	02:00	48	29	69	2.1
20.08.00	03:00	56	40	70	2.8
20.08.00	04:00	45	29	55	1.3
20.08.00	05:00	48	35	68	1.1
20.08.00	06:00	51	31	74	2.5
20.08.00	07:00	94	106	117	6.5
20.08.00	08:00	101	90	102	5.1
20.08.00	09:00	77	47	91	2.3
20.08.00	10:00	41	36	82	1.7
20.08.00	11:00	29	27	69	1.7

Table C: 1-h average concentrations at monitoring site TIJ.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
27.07.00	00:00	67	219	85	8.3	29.07.00	05:00	111			4.7
27.07.00	01:00	85	124	82	6.5	29.07.00	06:00	146			6.8
27.07.00	02:00	78	108	75	3.8	29.07.00	07:00	140			5.6
27.07.00	03:00	43	8	48	0.6	29.07.00	08:00	108			3.3
27.07.00	04:00	53	3	39	0.1	29.07.00	09:00	154			5.8
27.07.00	05:00	26	23	50	0.4	29.07.00	10:00	69			2.9
27.07.00	06:00	56	58	53	1.0	29.07.00	11:00	44			2.6
27.07.00	07:00	30	23	47	1.6	29.07.00	12:00	36			1.5
27.07.00	08:00	44	18	66	1.9	29.07.00	01:00	28			1.3
27.07.00	09:00	64	18	80	3.7	29.07.00	10:00	144	484	122	19.2
27.07.00	10:00	85	18	91	3.1	29.07.00	11:00	164	706	127	19.2
27.07.00	11:00	72	6	87	3.0	30.07.00	00:00	145	719	117	19.2
27.07.00	12:00	71	8	93	2.8	30.07.00	01:00	115	704	104	18.6
27.07.00	01:00	64	9	81	2.9	30.07.00	02:00	57	288	78	7.1
27.07.00	02:00	46	8	58	2.4	30.07.00	03:00	29	131	61	3.2
27.07.00	03:00	40			3.8	30.07.00	04:00	29	81	63	2.3
27.07.00	08:00	140			1.6	30.07.00	05:00	88	202	71	3.4
27.07.00	09:00	51			6.9	30.07.00	06:00	170	401	90	5.3
27.07.00	10:00	133			16.6	30.07.00	07:00	199	513	141	9.5
27.07.00	11:00	72			8.9	30.07.00	08:00	158	219	194	7.0
28.07.00	00:00	75			9.1	30.07.00	09:00	59	30	122	3.6
28.07.00	01:00	72			10.6	30.07.00	11:00	54	14	75	2.2
28.07.00	02:00	46			7.5	30.07.00	12:00	42	23	67	2.0
28.07.00	03:00	30			4.9	30.07.00	01:00	39			1.8
28.07.00	04:00	18			1.7	30.07.00	08:00	544			4.0
28.07.00	05:00	9			0.0	30.07.00	09:00	16	178	101	9.1
28.07.00	06:00	11			0.1	30.07.00	10:00	65	315	92	14.0
28.07.00	07:00	9			0.0	30.07.00	11:00	147	674	108	19.7
28.07.00	08:00	19			0.4						
28.07.00	09:00	31			1.5	05.08.00	11:00	67	17	74	6.7
28.07.00	10:00	48			2.2	05.08.00	12:00	21	8	43	1.9
28.07.00	11:00	55			3.6	05.08.00	01:00	22	18	47	2.6
28.07.00	12:00	45			2.3	05.08.00	02:00	22	11	40	1.7
28.07.00	01:00	31			1.7	05.08.00	03:00	23	9	36	0.8
28.07.00	02:00	25			1.5	05.08.00	04:00	23	5	34	0.9
28.07.00	03:00	18			0.9	05.08.00	05:00	28	8	48	2.0
28.07.00	04:00	16			0.8	05.08.00	06:00	28	21	83	3.2
28.07.00	05:00	18			1.0	05.08.00	07:00	63	61	146	7.7
28.07.00	06:00	12			0.5	05.08.00	08:00	147	365	151	13.1
28.07.00	07:00	9			0.9	05.08.00	09:00	75	172	133	9.9
28.07.00	08:00	17			2.1	05.08.00	10:00	100	305	137	14.1
28.07.00	09:00	30			7.1	05.08.00	11:00	147	495	130	13.9
28.07.00	10:00	69			9.3	06.08.00	00:00	94	370	106	10.5
28.07.00	11:00	110			11.4	06.08.00	01:00	56	105	83	4.0
29.07.00	00:00	143			18.4	06.08.00	02:00	29	12	59	0.8
29.07.00	01:00	119			15.4	06.08.00	03:00	42	7	52	0.4
29.07.00	02:00	92			9.6	06.08.00	04:00	31	12	48	0.5
29.07.00	03:00	94			7.0	06.08.00	05:00	19	11	44	0.5
29.07.00	04:00	80			5.4	06.08.00	06:00	43	78	60	1.7

Table C: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
06.08.00	07:00	78	46	80	1.9	08.08.00	08:00	51	25	72	2.4
06.08.00	08:00	92	30	99	2.3	08.08.00	09:00	52	17	79	2.7
06.08.00	09:00	72	18	76	2.2	08.08.00	10:00	54	10	78	2.9
06.08.00	10:00	63	17	71	2.6	08.08.00	11:00	68	9	73	2.5
06.08.00	11:00	61	58	80	1.6	08.08.00	12:00	37	27	70	2.6
06.08.00	12:00	26	20	35	2.1	08.08.00	01:00	35	14	47	1.9
06.08.00	01:00	19	17	55	2.2	08.08.00	02:00	34	9	36	1.3
06.08.00	02:00	25	9	38	1.2	08.08.00	03:00	18	7	27	0.9
06.08.00	03:00	28	5	30	0.9	08.08.00	04:00	19	10	36	1.6
06.08.00	04:00	26	4	27	0.5	08.08.00	05:00	13	4	33	0.9
06.08.00	05:00	23	6	37	1.0	08.08.00	06:00	12	5	44	1.3
06.08.00	06:00	26	16	75	3.0	08.08.00	07:00	14	5	49	1.3
06.08.00	07:00	72	172	141	8.7	08.08.00	08:00	17	7	60	2.4
06.08.00	08:00	77	168	112	7.0	08.08.00	09:00	17	8	77	3.4
06.08.00	09:00	17	6	68	2.0	08.08.00	10:00	31	14	75	3.3
06.08.00	10:00	27	35	102	4.4	08.08.00	11:00	14	15	68	2.6
06.08.00	11:00	44	115	113	6.5	09.08.00	00:00	34	23	66	2.9
07.08.00	00:00	56	169	111	6.2	09.08.00	01:00	16	15	52	1.1
07.08.00	01:00	78	102	105	5.5	09.08.00	02:00	38	5	49	0.8
07.08.00	02:00	99	136	90	5.2	09.08.00	03:00	33	3	42	0.4
07.08.00	03:00	64	104	85	4.0	09.08.00	04:00	22	5	35	0.0
07.08.00	04:00	56	157	83	3.8	09.08.00	05:00	9	0	16	
07.08.00	05:00	69	153	80	3.9	09.08.00	06:00	13	3	28	0.2
07.08.00	06:00	63	51	69	1.6	09.08.00	07:00	27	15	42	1.0
07.08.00	07:00	73	42	75	1.6	09.08.00	08:00	38	23	55	2.0
07.08.00	08:00	70	39	98	2.7	09.08.00	09:00	61	18	75	2.5
07.08.00	09:00	67	16	110	3.0	09.08.00	10:00	62	14	73	2.6
07.08.00	10:00	83	13	103	3.0	09.08.00	11:00	62	9	65	3.1
07.08.00	11:00	49	7	64	1.9	09.08.00	12:00	40	11	50	2.5
07.08.00	12:00	24	9	37	4.3	09.08.00	01:00	42	16	47	2.5
07.08.00	01:00	24	6	38	1.1	09.08.00	02:00	35	11	48	2.0
07.08.00	02:00	20	7	29	1.0	09.08.00	03:00	25	8	38	1.6
07.08.00	03:00	18	6	30	1.5	09.08.00	04:00	19	6	37	1.0
07.08.00	04:00	15	4	26	0.6	09.08.00	05:00	19	6	40	2.0
07.08.00	05:00	21	4	34	1.1	09.08.00	06:00	19	13	58	2.7
07.08.00	06:00	28	15	73	2.4	09.08.00	07:00	23	9	76	3.3
07.08.00	07:00	13	5	45	0.9	09.08.00	08:00	31	27	102	4.2
07.08.00	08:00	11	7	50	1.4	09.08.00	09:00	39	41	89	5.8
07.08.00	09:00	12	5	51	1.1	09.08.00	10:00	45	40	81	6.2
07.08.00	10:00	16	19	78	2.8	09.08.00	11:00	49	33	80	3.1
07.08.00	11:00	57	147	110	9.0	10.08.00	00:00	20	21	69	2.2
08.08.00	00:00	121	391	115	12.3	10.08.00	01:00	12	3	43	1.0
08.08.00	01:00	82	213	98	7.0	10.08.00	02:00	11	2	32	0.5
08.08.00	02:00	34	24	70	1.5	10.08.00	03:00	19	8	47	0.3
08.08.00	03:00	24	12	48	0.5	10.08.00	04:00	19	2	30	0.0
08.08.00	04:00	10	12	53	0.1	10.08.00	05:00	10	0	14	
08.08.00	05:00	33	18	52	0.3	10.08.00	06:00	12	2	24	0.5
08.08.00	06:00	36	15	44	0.4	10.08.00	07:00	17	9	31	0.8
08.08.00	07:00	29	14	46	0.9	10.08.00	08:00	27	15	44	2.4

Table C: continued.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
10.08.00	09:00	33	14	43	1.9
10.08.00	10:00	34	10	44	1.8
10.08.00	11:00	45	15	58	2.4
10.08.00	12:00	77	15	82	2.4
10.08.00	01:00	34	5	40	1.8
10.08.00	02:00	29	6	34	1.4
10.08.00	03:00	20	5	26	1.7
10.08.00	04:00	17	5	27	0.7
10.08.00	05:00	17	8	36	1.8
10.08.00	06:00	25	19	70	3.9
10.08.00	07:00	24	11	66	4.1
10.08.00	08:00	24	15	79	4.9
10.08.00	09:00	26	27	85	4.3
10.08.00	10:00	18	21	71	4.0
10.08.00	11:00	12	11	62	2.4
11.08.00	00:00	12	12	56	1.8
11.08.00	01:00	8	3	33	0.8
11.08.00	02:00	8	1	27	0.3
11.08.00	03:00	6	0	17	0.0
11.08.00	04:00	5	1	17	0.0
11.08.00	05:00	7	0	17	0.1
11.08.00	06:00	14	1	19	0.2
11.08.00	07:00	16	6	25	0.4
11.08.00	08:00	23	6	22	1.1
11.08.00	09:00	29	12	35	2.0
11.08.00	10:00	24	6	31	1.3
11.08.00	11:00	31	9	35	2.4
11.08.00	12:00	29	6	29	3.9
11.08.00	01:00	23	6	29	2.7
11.08.00	02:00	28	10	31	2.2
11.08.00	03:00	15	5	18	0.6
11.08.00	04:00	11	5	20	0.4
11.08.00	05:00	11	5	29	1.7
11.08.00	06:00	13	12	52	1.9
11.08.00	07:00	14	9	57	2.6
11.08.00	08:00	21	8	69	2.1
11.08.00	09:00	19	12	77	2.9
11.08.00	10:00	18	13	55	2.3
11.08.00	11:00	17	20	60	2.5
12.08.00	00:00	14	21	55	1.8
12.08.00	01:00	8	5	40	1.1
12.08.00	02:00	5	0	15	0.1
12.08.00	03:00	5	1	11	
12.08.00	04:00	5	0	9	
12.08.00	05:00	6	2	18	0.0
12.08.00	06:00	13	8	30	0.3
12.08.00	07:00	27	20	46	1.1
12.08.00	08:00	41	19	58	1.9
12.08.00	09:00	48	18	76	3.8
12.08.00	10:00	47	13	62	2.6
12.08.00	11:00	61	11	66	2.4
12.08.00	12:00	54	7	65	2.4
12.08.00	01:00	40	12	53	2.2
12.08.00	02:00	28	8	36	1.6
12.08.00	03:00	38	11	38	1.3
12.08.00	04:00	18	4	25	0.8
12.08.00	05:00	18	5	32	1.6
12.08.00	06:00	15	7	46	1.9
12.08.00	07:00	10	4	38	0.7
12.08.00	08:00	10	5	46	1.1
12.08.00	09:00	10	7	55	1.6
12.08.00	10:00	39	49	92	5.2
12.08.00	11:00	40	32	72	3.0

Table D: 1-h average concentrations at monitoring site MID.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
09.06.00	00:00	4	3	29	0.6	11.06.00	01:00	32	2	47	0.8
09.06.00	01:00	10	7	40	0.9	11.06.00	02:00	22	5	39	0.5
09.06.00	02:00	0	1	25	0.5	11.06.00	03:00	13	1	26	0.2
09.06.00	03:00	0	1	16	0.3	11.06.00	04:00	8	1	21	0.2
09.06.00	04:00	1	1	10	0.2	11.06.00	05:00	8	1	19	0.2
09.06.00	05:00	13	11	32	0.4	11.06.00	06:00	10	3	25	0.2
09.06.00	06:00	17	11	39	0.6	11.06.00	07:00		12	39	0.6
09.06.00	07:00	20	14	36	0.5	11.06.00	08:00		16	50	0.8
09.06.00	08:00	14	9	30	0.5	11.06.00	09:00		10	51	1.1
09.06.00	09:00	4	3	12	0.4	11.06.00	10:00		4	34	0.8
09.06.00	10:00	10	4	15	0.4	11.06.00	11:00		4	23	0.6
09.06.00	11:00	8	3	10	0.5	11.06.00	12:00		3	17	0.5
09.06.00	12:00	10	7	17	0.8	11.06.00	01:00		3	12	0.6
09.06.00	01:00	7	4	12	0.5	11.06.00	02:00		3	12	0.6
09.06.00	02:00	12	8	23	1.1	11.06.00	03:00		5	17	0.4
09.06.00	03:00	11	5	20	0.8	11.06.00	04:00		3	15	0.3
09.06.00	04:00	7	3	16	0.6	11.06.00	05:00		4	17	0.4
09.06.00	05:00	5	4	18	0.7	11.06.00	06:00		4	21	0.5
09.06.00	06:00	4	4	22	0.8	11.06.00	07:00		4	25	0.6
09.06.00	07:00	3	3	28	0.7	11.06.00	08:00		3	27	0.6
09.06.00	08:00	6	5	48	1.2	11.06.00	09:00		5	32	0.8
09.06.00	09:00	11	3	47	1.2	11.06.00	10:00		4	34	0.8
09.06.00	10:00	12	4	40	1.2	11.06.00	11:00		4	35	0.8
09.06.00	11:00	16	4	40	1.1	12.06.00	00:00		3	21	0.4
10.06.00	00:00	15	5	48	1.0	12.06.00	01:00		1	20	0.4
10.06.00	01:00	17	3	45	0.9	12.06.00	02:00		1	10	0.5
10.06.00	02:00	19	3	45	0.6	12.06.00	03:00		1	19	0.1
10.06.00	03:00	18	2	45	0.7	12.06.00	04:00		0	17	0.0
10.06.00	04:00	11	1	30	0.3	12.06.00	05:00		1	26	0.1
10.06.00	05:00	18	6	42	0.6	12.06.00	06:00		6	40	0.4
10.06.00	06:00	23	13	49	0.8	12.06.00	07:00		13	45	0.6
10.06.00	07:00	27	24	65	1.4	12.06.00	08:00		12	45	0.7
10.06.00	08:00	50	23	66	1.9	12.06.00	09:00		6	31	0.6
10.06.00	09:00	54	12	50	1.2	12.06.00	10:00		5	24	0.5
10.06.00	10:00	17	6	34	0.9	12.06.00	11:00		4	22	0.6
10.06.00	11:00	9	7	24	0.9	12.06.00	12:00		2	17	0.4
10.06.00	12:00	8	5	18	0.7	12.06.00	01:00		2	19	0.5
10.06.00	01:00	10	6	25	0.8	12.06.00	02:00		4	13	0.4
10.06.00	02:00	12	5	29	0.8	12.06.00	03:00		3	13	0.4
10.06.00	03:00	14	4	28	0.7	12.06.00	04:00		2	10	0.2
10.06.00	04:00	13	4	27	0.7	12.06.00	05:00		4	21	0.6
10.06.00	05:00	12	4	32	0.8	12.06.00	06:00		4	30	0.7
10.06.00	06:00	12	7	45	1.3	12.06.00	07:00		3	43	0.9
10.06.00	07:00	11	7	55	1.6	12.06.00	08:00		4	55	1.3
10.06.00	08:00	9	7	54	1.4	12.06.00	09:00		13	72	2.0
10.06.00	09:00	14	13	90	2.5	12.06.00	10:00		8	58	1.5
10.06.00	10:00	54	48	109	3.8	12.06.00	11:00		6	50	1.4
10.06.00	11:00	26	8	66	1.5	13.06.00	00:00		4	32	0.7
11.06.00	00:00	29	6	58	1.2	13.06.00	01:00		3	27	0.7

Table D: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
13.06.00	02:00		4	41	0.8	15.06.00	03:00		1	40	0.5
13.06.00	03:00		6	47	0.5	15.06.00	04:00		1	30	0.2
13.06.00	04:00		2	36	0.4	15.06.00	05:00		1	27	0.3
13.06.00	05:00		2	52	0.7	15.06.00	06:00		3	37	0.3
13.06.00	06:00		10	59	0.8	15.06.00	07:00		9	49	0.6
13.06.00	07:00		17	62	1.0	15.06.00	08:00		12	50	1.0
13.06.00	08:00		5	34	0.5	15.06.00	09:00		4	52	1.0
13.06.00	09:00		3	23	0.3	15.06.00	10:00		4	47	0.9
13.06.00	10:00		1	9	0.1	15.06.00	11:00		4	27	0.6
13.06.00	11:00		1	6	0.1	15.06.00	12:00		3	16	0.5
13.06.00	12:00		1	7	0.2	15.06.00	01:00		4	19	0.5
13.06.00	01:00		1	5	0.1	15.06.00	02:00		4	17	0.4
13.06.00	02:00		1	6	0.1	15.06.00	03:00		2	11	0.3
13.06.00	03:00		1	7	0.1	15.06.00	04:00		2	17	0.5
13.06.00	04:00		1	8	0.2	15.06.00	05:00		2	17	0.5
13.06.00	05:00		1	13	0.2	15.06.00	06:00		5	31	0.9
13.06.00	06:00		2	24	0.3	15.06.00	07:00		4	47	1.2
13.06.00	07:00		3	48	0.7	15.06.00	08:00		6	52	1.0
13.06.00	08:00		9	86	1.6	15.06.00	09:00		9	72	1.6
13.06.00	09:00		7	77	1.7	15.06.00	10:00		8	87	2.2
13.06.00	10:00		13	81	2.0	15.06.00	11:00		4	58	1.0
13.06.00	11:00		36	99	3.2	16.06.00	00:00		3	40	0.6
14.06.00	00:00		27	89	2.8	16.06.00	01:00		3	49	0.7
14.06.00	01:00		12	83	1.9	16.06.00	02:00		8	70	1.4
14.06.00	02:00		4	58	1.1	16.06.00	03:00		10	73	1.5
14.06.00	03:00		9	69	1.1	16.06.00	04:00		2	52	0.8
14.06.00	04:00		1	43	0.6	16.06.00	05:00		3	51	0.5
14.06.00	05:00		1	31	0.2	16.06.00	06:00		4	42	0.5
14.06.00	06:00		5	43	0.4	16.06.00	07:00		8	46	0.6
14.06.00	07:00		10	49	0.6	16.06.00	08:00		7	45	0.8
14.06.00	08:00		11	45	0.8	16.06.00	09:00		3	24	0.3
14.06.00	09:00		5	27	0.5	16.06.00	10:00		2	12	0.2
14.06.00	10:00		3	23	0.5	16.06.00	11:00		3	11	0.2
14.06.00	11:00		3	17	0.4	16.06.00	12:00		2	9	0.3
14.06.00	12:00		3	15	0.3	16.06.00	01:00		2	11	0.2
14.06.00	01:00		2	12	0.3	16.06.00	02:00		3	13	0.4
14.06.00	02:00		3	11	0.3	16.06.00	03:00		2	14	0.3
14.06.00	03:00		3	11	0.2	16.06.00	04:00		1	9	0.1
14.06.00	04:00		2	14	0.3	16.06.00	05:00		1	10	0.1
14.06.00	05:00		3	27	0.6	16.06.00	06:00		2	30	0.7
14.06.00	06:00		2	38	0.8	16.06.00	07:00		3	53	1.1
14.06.00	07:00		2	44	0.9	16.06.00	08:00		10	99	2.3
14.06.00	08:00		3	52	1.0	16.06.00	09:00		3	78	1.8
14.06.00	09:00		8	81	2.0	16.06.00	10:00		47	138	4.9
14.06.00	10:00		43	123	4.2	16.06.00	11:00		21	116	3.1
14.06.00	11:00		12	110	2.5	16.06.00	12:00		3	40	0.6
15.06.00	00:00		14	92	2.1	16.06.00	01:00		3	49	0.7
15.06.00	01:00		14	99	2.1	16.06.00	02:00		8	70	1.4
15.06.00	02:00		5	73	1.0	16.06.00	03:00		10	73	1.5

Table D: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
16.06.00	04:00		2	52	0.8
16.06.00	05:00		3	51	0.5
16.06.00	06:00		4	42	0.5
16.06.00	07:00		8	46	0.6
16.06.00	08:00		7	45	0.8
16.06.00	09:00		3	24	0.3
16.06.00	10:00		2	12	0.2
16.06.00	11:00		3	11	0.2
16.06.00	12:00		2	9	0.3
16.06.00	01:00		2	11	0.2
16.06.00	02:00		3	13	0.4
16.06.00	03:00		2	14	0.3
16.06.00	04:00		1	9	0.1
16.06.00	05:00		1	10	0.1
16.06.00	06:00		2	30	0.7
16.06.00	07:00		3	53	1.1
16.06.00	08:00		10	99	2.3
16.06.00	09:00		3	78	1.8
16.06.00	10:00		47	138	4.9
16.06.00	11:00		21	116	3.1
19.07.00	00:00	39	4	30	0.3
19.07.00	01:00	14	2	21	
19.07.00	02:00	3	2	8	
19.07.00	03:00	5	0	5	
19.07.00	04:00	4	0	8	
19.07.00	05:00	13	1	16	
19.07.00	06:00	19	2	11	
19.07.00	07:00	43	12	38	0.3
19.07.00	08:00	37	9	24	0.2
19.07.00	09:00	26	8	22	0.3
19.07.00	10:00	41	7	45	1.0
19.07.00	11:00	39	5	42	0.8
19.07.00	12:00	35	3	37	0.6
19.07.00	01:00	21	4	24	0.6
19.07.00	02:00	17	7	24	0.4
19.07.00	03:00	16	7	25	0.5
19.07.00	04:00	13	5	23	0.2
19.07.00	05:00	8	5	20	0.2
19.07.00	06:00	7	4	25	0.4
19.07.00	07:00	7	6	34	0.7
19.07.00	08:00	6	4	36	0.7
19.07.00	09:00	5	6	37	0.6
19.07.00	10:00	5	4	35	0.6
19.07.00	11:00	29	19	66	1.0
20.07.00	00:00	19	13	65	1.5
20.07.00	01:00	25	4	31	0.3
20.07.00	02:00	2	1	12	
20.07.00	03:00	3	1	9	
20.07.00	04:00	10	1	11	
20.07.00	05:00	14	1	14	
20.07.00	06:00	12	2	19	
20.07.00	07:00	18	5	19	0.0
20.07.00	08:00	36	12	33	0.4
20.07.00	09:00	38	8	33	0.4
20.07.00	10:00	42	10	35	0.4
20.07.00	11:00	16	5	14	0.1
20.07.00	12:00	16	4	12	0.1
20.07.00	01:00	16	4	14	0.0
20.07.00	02:00	14	4	15	0.1
20.07.00	03:00	13	4	16	0.1
20.07.00	04:00	13	4	16	0.1
20.07.00	05:00	10	5	19	0.1
20.07.00	06:00	7	4	14	0.0
20.07.00	07:00	13	9	29	0.6
20.07.00	08:00	7	9	27	2.1
20.07.00	09:00	10	15	47	3.9
20.07.00	10:00	7	9	39	2.2
20.07.00	11:00	42	18	64	2.5
21.07.00	00:00	11	7	32	1.5
21.07.00	01:00	15	3	28	0.6
21.07.00	02:00	7	3	27	
21.07.00	03:00	10	2	26	
21.07.00	04:00	12	1	20	
21.07.00	05:00	17	10	35	0.2
21.07.00	06:00	21	13	33	
21.07.00	07:00	16	5	21	
21.07.00	08:00	24	9	32	0.2
21.07.00	09:00	27	8	40	0.7
21.07.00	10:00	18	4	23	0.0
21.07.00	11:00	14	2	14	0.1
21.07.00	12:00	12	3	13	
21.07.00	01:00	15	2	14	0.1
21.07.00	02:00	12	3	16	0.1
21.07.00	03:00	12	4	14	0.1
21.07.00	04:00	11	3	10	
21.07.00	05:00	8	4	13	0.0
21.07.00	06:00	8	3	12	
21.07.00	07:00	12	8	37	0.7
21.07.00	08:00	12	13	59	1.7
21.07.00	09:00	11	12	49	1.3
21.07.00	10:00	7	6	41	0.9
21.07.00	11:00	27	29	68	1.3
22.07.00	00:00	32	51	76	2.0
22.07.00	01:00	16	10	53	0.6
22.07.00	02:00	3	2	20	
22.07.00	03:00	5	0	16	
22.07.00	04:00	15	1	22	

Table D: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
22.07.00	05:00	28	3	38		24.07.00	06:00	24	3	26	
22.07.00	06:00	26	12	39	0.1	24.07.00	07:00	33	14	39	0.3
22.07.00	07:00	53	47	61	1.2	24.07.00	08:00	100	28	55	0.7
22.07.00	08:00	89	62	107	2.6	24.07.00	09:00	70	15	54	1.0
22.07.00	09:00	64	24	96	1.6	24.07.00	10:00	63	10	48	0.9
22.07.00	10:00	36	8	40	0.5	24.07.00	11:00	36	5	29	0.4
22.07.00	11:00	27	3	22	0.2	24.07.00	12:00	21	3	21	0.3
22.07.00	12:00	20	2	19	0.1	24.07.00	01:00	19	5	24	0.1
22.07.00	01:00	14	3	18	0.2	24.07.00	02:00	20	4	20	0.1
22.07.00	02:00	16	4	22	0.2	24.07.00	03:00	16	4	12	0.1
22.07.00	03:00	12	5	17	0.0	24.07.00	04:00	14	4	13	
22.07.00	04:00	10	5	14		24.07.00	05:00	11	6	17	0.1
22.07.00	05:00	10	5	20	0.1	24.07.00	06:00	13	7	25	0.4
22.07.00	06:00	9	6	30	0.3	24.07.00	07:00	21	10	48	1.0
22.07.00	07:00	11	7	52	0.8	24.07.00	08:00	32	20	74	2.4
22.07.00	08:00	7	5	45	0.7	24.07.00	09:00	38	54	95	4.1
22.07.00	09:00	9	9	51	1.1	24.07.00	10:00	31	22	78	2.0
22.07.00	10:00	11	13	57	1.4	24.07.00	11:00	30	24	71	1.7
22.07.00	11:00	42	37	75	1.8	25.07.00	00:00	41	21	69	1.3
23.07.00	00:00	6	4	34	0.3	25.07.00	01:00	55	21	69	0.7
23.07.00	01:00	3	1	22		25.07.00	02:00	22	8	59	0.5
23.07.00	02:00	2	1	10		25.07.00	03:00	16	3	51	0.4
23.07.00	03:00	33	1	37		25.07.00	04:00	28	12	58	0.3
23.07.00	04:00	11	1	22		25.07.00	05:00	34	20	53	0.5
23.07.00	05:00	17	1	28		25.07.00	06:00	38	27	53	0.6
23.07.00	06:00	40	11	47	0.0	25.07.00	07:00	42	38	57	1.1
23.07.00	07:00	52	22	53	0.3	25.07.00	08:00	101	59	116	2.4
23.07.00	08:00	56	28	67	1.0	25.07.00	09:00	91	16	106	1.7
23.07.00	09:00	54	13	66	1.0	25.07.00	10:00	44	5	50	0.6
23.07.00	10:00	64	9	66	1.0	25.07.00	11:00	35	5	34	0.6
23.07.00	11:00	35	4	37	0.5	25.07.00	12:00	25	3	26	0.3
23.07.00	12:00	18	3	21	0.1	25.07.00	01:00	23	3	21	0.1
23.07.00	01:00	21	4	25	0.2	25.07.00	02:00	21	5	24	0.1
23.07.00	02:00	21	4	25	0.2	25.07.00	03:00	21			0.2
23.07.00	03:00	17	5	16	0.1	25.07.00	04:00	19			0.1
23.07.00	04:00	15	5	18	0.1	25.07.00	05:00	16			0.2
23.07.00	05:00	12	5	16	0.0	25.07.00	06:00	18			0.8
23.07.00	06:00	16	6	29	0.4	25.07.00	07:00	23			1.8
23.07.00	07:00	16	9	40	1.0	25.07.00	08:00	22	14	69	1.7
23.07.00	08:00	18	13	59	1.8	25.07.00	09:00	23	13	76	2.0
23.07.00	09:00	29	11	42	1.2	25.07.00	10:00	22	17	80	2.6
23.07.00	10:00	19	14	55	1.5	25.07.00	11:00	29	16	75	1.9
23.07.00	11:00	39	9	54	1.0						
24.07.00	00:00	12	7	35	0.6						
24.07.00	01:00	11	3	31	0.3						
24.07.00	02:00	9	1	20							
24.07.00	03:00	9	0	17							
24.07.00	04:00	24	1	28							
24.07.00	05:00	14	1	22							

Table E: 1-h average concentrations at monitoring site DUM.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3	Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
01.06.00	00:00	16	34	69	0.5	03.06.00	01:00	4	4	37	0.3
01.06.00	01:00	235	269	282	1.6	03.06.00	02:00	0	1	1	
01.06.00	02:00	191	233	199	1.2	03.06.00	03:00	0	0	0	
01.06.00	03:00	11	20	51	0.3	03.06.00	04:00	0	1	5	
01.06.00	04:00	10	8	43	0.1	03.06.00	05:00	0	1	3	
01.06.00	05:00	11	6	34	0.0	03.06.00	06:00	2	2	9	
01.06.00	06:00	19	19	35	0.0	03.06.00	07:00	5	3	11	
01.06.00	07:00	31	24	47	0.2	03.06.00	08:00	8	6	21	
01.06.00	08:00	32	17	51	0.3	03.06.00	09:00	2	3	10	
01.06.00	09:00	18	5	28	0.1	03.06.00	10:00	1	4	11	
01.06.00	10:00	16	4	27	0.1	03.06.00	11:00	0	2	6	
01.06.00	11:00	15	3	15		03.06.00	12:00	0	2	6	
01.06.00	12:00	12	2	11		03.06.00	01:00	1	3	8	
01.06.00	01:00	6	2	9		03.06.00	02:00	1	3	13	
01.06.00	02:00	6	2	11		03.06.00	03:00	0	1	8	
01.06.00	03:00	7	2	9		03.06.00	04:00	0	1	5	
01.06.00	04:00	8	2	21		03.06.00	05:00	0	1	6	
01.06.00	05:00	6	1	15		03.06.00	06:00	16	2	10	
01.06.00	06:00	4	1	15	0.0	03.06.00	07:00	1	2	13	
01.06.00	07:00	11	8	48	0.6	03.06.00	08:00	12	3	24	
01.06.00	08:00	6	3	21	0.3	03.06.00	09:00	0	2	14	
01.06.00	09:00	7	3	23	0.2	03.06.00	10:00	0	2	11	
01.06.00	10:00	18	39	78	1.8	03.06.00	11:00	0	2	9	
01.06.00	11:00	22	72	87	2.4	04.06.00	00:00	1	1	8	
02.06.00	00:00	19	48	87	2.0	04.06.00	01:00	0	1	4	
02.06.00	01:00	19	81	81	2.5	04.06.00	02:00	0	0	2	
02.06.00	02:00	18	58	71	1.5	04.06.00	03:00	0	0	0	
02.06.00	03:00	12	10	65	0.5	04.06.00	04:00	0	0	0	
02.06.00	04:00	11	11	57	0.4	04.06.00	05:00	0	0	0	
02.06.00	05:00	6	3	38	0.2	04.06.00	06:00	25	1	10	
02.06.00	06:00	14	10	35	0.1	04.06.00	07:00	21	5	18	
02.06.00	07:00	10	4	21	0.0	04.06.00	08:00	10	4	16	
02.06.00	08:00	26	3	20	0.0	04.06.00	09:00	11	3	14	
02.06.00	09:00	14	3	25	0.0	04.06.00	10:00	8	4	16	0.1
02.06.00	10:00	18	3	17		04.06.00	11:00	4	4	13	0.8
02.06.00	11:00	12	2	13		04.06.00	12:00	0	1	3	0.2
02.06.00	12:00	10	1	13		04.06.00	01:00	0	2	11	0.3
02.06.00	01:00	6	1	8		04.06.00	02:00	2	3	16	0.4
02.06.00	02:00	7	1	10		04.06.00	03:00	1	2	7	0.2
02.06.00	03:00	5	2	14		04.06.00	04:00	2	1	8	0.3
02.06.00	04:00	2	2	10		04.06.00	05:00	6	2	18	0.4
02.06.00	05:00	1	1	7		04.06.00	06:00	21	2	18	0.4
02.06.00	06:00	1	1	12		04.06.00	07:00	6	2	17	0.4
02.06.00	07:00	4	4	31	0.1	04.06.00	08:00	3	4	32	0.9
02.06.00	08:00	0	2	22	0.1	04.06.00	09:00	10	16	48	2.2
02.06.00	09:00	5	10	50	0.5	04.06.00	10:00	15	20	74	3.0
02.06.00	10:00	8	10	50	0.6	04.06.00	11:00	14	11	64	1.9
02.06.00	11:00	10	19	51	1.1	05.06.00	00:00	14	18	72	2.3
03.06.00	00:00	6	5	45	0.3	05.06.00	01:00	14	25	73	2.7

Table E: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
05.06.00	02:00	10	17	66	2.5	07.06.00	01:00	4	3	17	0.3
05.06.00	03:00	8	5	53	1.3	07.06.00	02:00	1	4	13	0.3
05.06.00	04:00	5	2	29	1.0	07.06.00	03:00	0	2	8	0.3
05.06.00	05:00	3	1	24	0.5	07.06.00	04:00	0	2	7	0.1
05.06.00	06:00	5	4	27	0.5	07.06.00	05:00	1	3	12	0.2
05.06.00	07:00	15	14	40	0.8	07.06.00	06:00	39	4	22	0.4
05.06.00	08:00	17	9	32	0.8	07.06.00	07:00	0	2	14	0.3
05.06.00	09:00	20	7	35	0.9	07.06.00	08:00	0	2	17	0.5
05.06.00	10:00	22	5	35	0.8	07.06.00	09:00	3	6	29	0.7
05.06.00	11:00	17	3	21	0.5	07.06.00	10:00	0	4	21	0.7
05.06.00	12:00	6	1	12	0.3	07.06.00	11:00	0	2	16	0.4
05.06.00	01:00	1	2	10	0.3						
05.06.00	02:00	5	2	12	0.3	11.07.00	00:00		1	9	0.0
05.06.00	03:00	7	2	12	0.2	11.07.00	01:00		1	9	0.1
05.06.00	04:00	3	1	9	0.2	11.07.00	02:00		0	1	
05.06.00	05:00	3	1	8	0.2	11.07.00	03:00		0		
05.06.00	06:00	19	2	15	0.4	11.07.00	04:00		0		
05.06.00	07:00	6	1	11	0.3	11.07.00	05:00		0	0	
05.06.00	08:00	3	1	5	0.1	11.07.00	06:00	0	2	15	
05.06.00	09:00	4	1	7	0.2	11.07.00	07:00	17	25	57	0.8
05.06.00	10:00	3	3	22	0.6	11.07.00	08:00	14	14	63	0.9
05.06.00	11:00	4	5	28	0.8	11.07.00	09:00	36	11	92	1.7
06.06.00	00:00	3	3	24	0.6	11.07.00	10:00	38	7	79	1.5
06.06.00	01:00	5	14	43	1.2	11.07.00	11:00	26	3	59	1.7
06.06.00	02:00	6	10	56	1.3	11.07.00	12:00	17	4	41	1.0
06.06.00	03:00	5	3	49	0.4	11.07.00	01:00	6	3	17	0.2
06.06.00	04:00	5	1	28	0.1	11.07.00	02:00	7	5	19	0.2
06.06.00	05:00	7	2	30	0.3	11.07.00	03:00	5	5	15	0.1
06.06.00	06:00	10	7	31	0.4	11.07.00	10:00	11	113	104	4.8
06.06.00	07:00	19	15	38	0.7	11.07.00	11:00	37	209	110	10.9
06.06.00	08:00	19	14	42	0.9	12.07.00	00:00	18	108	93	6.3
06.06.00	09:00	29	10	43	0.9	12.07.00	01:00	26	140	75	6.3
06.06.00	10:00	39	6	33	0.6	12.07.00	02:00	16	119	75	5.4
06.06.00	11:00	27	3	31	0.6	12.07.00	03:00	7	38	64	2.4
06.06.00	12:00	21	1	23	0.5	12.07.00	04:00	4	7	53	1.2
06.06.00	01:00	11	2	15	0.3	12.07.00	05:00	9	13	55	0.9
06.06.00	02:00	10	2	15	0.3	12.07.00	06:00	13	13	49	0.6
06.06.00	03:00	8	2	14	0.2	12.07.00	07:00	19	18	57	0.8
06.06.00	04:00	4	2	8	0.1	12.07.00	08:00	23	18	68	1.3
06.06.00	05:00	3	2	9	0.1	12.07.00	09:00	10	6	40	0.7
06.06.00	06:00	3	2	13	0.3	12.07.00	10:00	18	6	33	0.6
06.06.00	07:00	3	1	11	0.1	12.07.00	11:00	11	8	34	0.7
06.06.00	08:00	6	1	21	0.5	12.07.00	12:00	4	3	13	
06.06.00	09:00	3	1	15	0.4	12.07.00	01:00	10	3	13	0.1
06.06.00	10:00	3	5	22	0.8	12.07.00	07:00	24	16	37	0.3
06.06.00	11:00	8	7	40	1.1	12.07.00	08:00	0	10	28	0.6
07.06.00	00:00	17	34	75	2.6	12.07.00	10:00	20	58	55	3.3
07.06.00	11:00	6	1	22	0.3	12.07.00	11:00	23	147	70	6.1
07.06.00	12:00	4	2	17	0.3	13.07.00	00:00	35	198	74	6.9

Table E: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
13.07.00	01:00	8	47	56	2.6	15.07.00	07:00	13	14	28	0.1
13.07.00	02:00	16	76	59	2.6	15.07.00	08:00	16	14	41	0.6
13.07.00	03:00	6	23	50	1.5	15.07.00	09:00	12	7	30	0.4
13.07.00	04:00	4	12	41	0.6	15.07.00	10:00	4	2	11	
13.07.00	05:00	7	21	40	0.6	15.07.00	11:00	6	2	6	
13.07.00	06:00	22	33	45	1.1	15.07.00	12:00	7	3	7	
13.07.00	07:00	30	33	57	0.9	15.07.00	01:00	7	3	7	
13.07.00	08:00	34	37	74	1.6	15.07.00	02:00	13	4	9	
13.07.00	09:00	18	7	43	1.0	15.07.00	03:00	6	3	6	
13.07.00	10:00	29	11	43	1.7	15.07.00	04:00	6	3	8	
13.07.00	11:00	28	12	40	1.3	15.07.00	05:00	4			
13.07.00	12:00	15	3	11	0.1	15.07.00	06:00	0	2	15	0.0
13.07.00	01:00	19	3	9	0.1	15.07.00	07:00		2	17	0.1
13.07.00	07:00	52	7	15	0.2	15.07.00	08:00		2	17	0.2
13.07.00	08:00		2	21	0.3	15.07.00	09:00		2	10	0.0
13.07.00	09:00		3	17	0.2	15.07.00	10:00	0	4	18	0.2
13.07.00	10:00		2	14	0.1	15.07.00	11:00	1	1	11	
13.07.00	11:00		2	12	0.1	16.07.00	00:00	8	18	59	1.6
14.07.00	00:00		1	8	0.0	16.07.00	01:00	3	6	43	1.2
14.07.00	01:00		1	7	0.0	16.07.00	02:00	2	5	35	0.5
14.07.00	02:00		1	4	0.0	16.07.00	03:00	2	1	26	0.2
14.07.00	03:00		1	9	0.0	16.07.00	04:00	2	0	12	
14.07.00	04:00		1		0.0	16.07.00	05:00	2	0	11	
14.07.00	05:00		0		0.0	16.07.00	06:00	5	1	16	
14.07.00	06:00		0	0	0.0	16.07.00	07:00	14	6	31	0.2
14.07.00	07:00	1	1	1	0.0	16.07.00	08:00	12	7	29	0.3
14.07.00	08:00	9	2	11	0.0	16.07.00	09:00	10	6	28	0.4
14.07.00	09:00	13	1	9	0.0	16.07.00	10:00	17	9	34	0.9
14.07.00	10:00	17	2	20	0.0	16.07.00	11:00	11	7	25	0.7
14.07.00	11:00	6	2	6	0.0	16.07.00	12:00	12	6	21	0.5
14.07.00	12:00	5	1	2	0.0	16.07.00	01:00	12	3	14	0.0
14.07.00	01:00	7	2	2	0.0	16.07.00	02:00	19	5	13	
14.07.00	02:00	8	2	4	0.0	16.07.00	03:00	12	3	9	
14.07.00	03:00	8	2	4	0.0	16.07.00	04:00	8	3	22	
14.07.00	04:00	7			0.0	16.07.00	05:00	5	3	13	
14.07.00	05:00	5			0.0	16.07.00	06:00	4	3	13	
14.07.00	06:00		2	18	0.0	16.07.00	07:00	0	3	16	0.1
14.07.00	07:00	0	2	13	0.0	16.07.00	08:00	2	4	19	0.1
14.07.00	08:00	0	2	17	0.2	16.07.00	09:00	1	4	16	0.0
14.07.00	09:00		3	16	0.2	16.07.00	10:00		4	16	0.1
14.07.00	10:00		3	20	0.2	16.07.00	11:00		4	17	0.0
14.07.00	11:00	0	2	16	0.1	17.07.00	00:00	2	8	30	0.8
15.07.00	00:00		2	11	0.0	17.07.00	01:00		6	12	
15.07.00	01:00		1	4		17.07.00	02:00		1	6	
15.07.00	02:00		1	1		17.07.00	03:00		0	0	
15.07.00	03:00		1			17.07.00	04:00		0		
15.07.00	04:00		0			17.07.00	05:00	0	0		
15.07.00	05:00		1	2		17.07.00	06:00	1	1		
15.07.00	06:00	3	2	8		17.07.00	07:00	3	2	2	

Table E: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
17.07.00	08:00	4	3	6	
17.07.00	09:00	4	3	6	
17.07.00	10:00	5	3	7	
17.07.00	11:00	7	3	8	
17.07.00	12:00	8	4	9	
17.07.00	01:00	10	3	9	
17.07.00	02:00	17	4	12	
17.07.00	03:00	7	3	28	
17.07.00	04:00	4	3	9	
17.07.00	05:00	5	3	8	
17.07.00	06:00	4	3	9	
17.07.00	07:00	3	3	16	
17.07.00	08:00	1	3	13	
17.07.00	09:00		3	14	
17.07.00	10:00		3	9	
17.07.00	11:00	0	3	8	

Table F: 1-h average concentrations at monitoring site DW2.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3	Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
28.09.00	00:00	37	2	36		30.09.00	01:00	4	1	7	
28.09.00	01:00	29	1	26		30.09.00	02:00	8	0	12	
28.09.00	02:00	12	0	10		30.09.00	03:00	15	1	18	
28.09.00	03:00	10	1	10		30.09.00	04:00	24	3	32	
28.09.00	04:00	29	1	20		30.09.00	05:00	43	21	37	0.6
28.09.00	05:00	42	8	35	0.5	30.09.00	06:00	73	33	60	0.5
28.09.00	06:00	39	11	36	0.1	30.09.00	07:00	45	14	46	0.2
28.09.00	07:00	37	8	32	0.1	30.09.00	08:00	41	9	42	0.2
28.09.00	08:00	24	3	14		30.09.00	09:00	30	4	30	0.1
28.09.00	09:00	25	3	19		30.09.00	10:00	8	1	5	
28.09.00	10:00	22	2	10		30.09.00	11:00	8	1	6	
28.09.00	11:00	9	1	4		30.09.00	12:00	8	1	7	
28.09.00	12:00	10	2	8		30.09.00	01:00	10	1	8	
28.09.00	01:00	12	4	21		30.09.00	02:00	10	1	12	
28.09.00	02:00	6	3	19		30.09.00	03:00	19	1	18	
28.09.00	03:00	9	2	22		30.09.00	04:00	49	1	33	0.4
28.09.00	04:00	9	2	30	0.6	30.09.00	05:00	41	1	34	0.4
28.09.00	05:00	9	2	31	0.3	30.09.00	06:00	26	3	55	0.8
28.09.00	06:00	10	2	34	0.5	30.09.00	07:00	37	3	50	0.6
28.09.00	07:00	13	5	44	0.9	30.09.00	08:00	58	34	70	2.4
28.09.00	08:00	10	2	36	0.5	30.09.00	09:00	35	11	64	1.1
28.09.00	09:00	7	2	30	0.3	30.09.00	10:00	22	3	42	0.3
28.09.00	10:00	8	2	34	0.2	30.09.00	11:00	28	1	33	0.0
28.09.00	11:00	7	1	19		01.10.00	00:00	14	0	12	
29.09.00	00:00	9	1	12		01.10.00	01:00	13	0	23	
29.09.00	01:00	6	1	10		01.10.00	02:00	20	0	15	
29.09.00	02:00	9	1	17		01.10.00	03:00	14	0	8	
29.09.00	03:00	20	1	25		01.10.00	04:00	7	0	4	
29.09.00	04:00	10	0	9		01.10.00	05:00	25	2	15	
29.09.00	05:00	4	1	5		01.10.00	06:00	13	3	10	
29.09.00	06:00	7	2	6		01.10.00	07:00	15	3	10	
29.09.00	07:00	6	1	6		01.10.00	08:00	10	2	7	
29.09.00	08:00	10	1	8		01.10.00	09:00	6	1	3	
29.09.00	09:00	10	2	7		01.10.00	10:00	6	1	3	
29.09.00	10:00	8	2	4		01.10.00	11:00	9	1	6	
29.09.00	11:00	7	2	9		01.10.00	12:00	15	1	13	
29.09.00	12:00	8	3	15		01.10.00	01:00	17	2	17	
29.09.00	01:00	7	3	16		01.10.00	02:00	13	1	13	
29.09.00	02:00	8	3	13		01.10.00	03:00	13	1	14	
29.09.00	03:00	9	2	18		01.10.00	04:00	49	1	43	0.4
29.09.00	04:00	8	1	25	0.1	01.10.00	05:00	29	2	45	0.8
29.09.00	05:00	26	2	30	0.2	01.10.00	06:00	94	4	44	0.5
29.09.00	06:00	8	2	32	0.4	01.10.00	07:00	42	3	37	0.8
29.09.00	07:00		1	25	0.2	01.10.00	08:00	29	1	29	0.7
29.09.00	08:00	4	1	27	0.1	01.10.00	09:00	34	1	35	0.1
29.09.00	09:00	8	1	30	0.1	01.10.00	10:00	37	1	31	0.0
29.09.00	10:00	12	2	32	0.0	01.10.00	11:00	26	1	26	
29.09.00	11:00	5	1	13		02.10.00	00:00	27	1	24	
30.09.00	00:00	5	0	5		02.10.00	01:00	19	0	23	

Table F: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
02.10.00	03:00	17	1	20	
02.10.00	03:00	20	9	36	
02.10.00	04:00	42	50	51	0.6
02.10.00	05:00	54	74	59	1.1
02.10.00	06:00	59	50	68	0.8
02.10.00	07:00	36	4	24	
02.10.00	08:00	25	2	13	
02.10.00	09:00	9	1	6	
02.10.00	10:00	12	1	6	
02.10.00	02:00		0	9	
02.10.00	03:00	4	1	13	
02.10.00	04:00	68	1	38	0.0
02.10.00	05:00	81	2	47	0.6
02.10.00	06:00	26	1	32	0.1
02.10.00	07:00	30	1	39	0.5
02.10.00	08:00	50	1	26	0.2
02.10.00	09:00	59	49	62	1.7
02.10.00	10:00	80	150	76	4.7
02.10.00	11:00	51	120	65	4.3
03.10.00	00:00	60	100	62	3.0
03.10.00	01:00	59	153	69	3.8
03.10.00	02:00	40	139	60	3.5
03.10.00	03:00	37	118	55	2.9
03.10.00	04:00	73	115	65	1.4
03.10.00	05:00	78	105	75	1.8
03.10.00	06:00	93	81	92	1.4
03.10.00	07:00	46	10	44	0.1
03.10.00	08:00	17	2	10	
03.10.00	09:00	12	1	4	
03.10.00	10:00	10	1	3	
03.10.00	11:00	6	1	2	
03.10.00	12:00	8	1	9	
03.10.00	01:00	13	1	6	
03.10.00	02:00	8	1	7	
03.10.00	03:00	15	1	13	
03.10.00	04:00	63	5	37	0.1
03.10.00	05:00	148	6	59	0.4
03.10.00	06:00	67	32	68	2.0
03.10.00	07:00	68	41	74	2.1
03.10.00	08:00	44	2	48	0.3
03.10.00	09:00	42	1	35	
03.10.00	10:00	35	1	27	
03.10.00	11:00	52	4	42	0.1
04.10.00	00:00	41	27	53	0.7
04.10.00	01:00	31	33	51	0.7
04.10.00	02:00	25	3	46	0.0
04.10.00	03:00	27	9	32	0.0
04.10.00	04:00	53	17	28	0.0
04.10.00	05:00	68	38	54	0.8
04.10.00	06:00	91	26	58	0.4
04.10.00	07:00	31	5	21	
04.10.00	08:00	19	2	9	
04.10.00	09:00	16	1	4	
04.10.00	12:00	8	1	7	
04.10.00	01:00	9	1	8	
04.10.00	02:00	15	2	12	
04.10.00	03:00	21	2	21	
04.10.00	04:00	33	2	38	0.3
04.10.00	05:00	36	2	44	0.3
04.10.00	06:00	25	1	38	0.2
04.10.00	07:00	24	3	49	0.8
04.10.00	08:00	20	1	33	0.3
04.10.00	09:00	36	2	38	0.2
04.10.00	10:00	29	2	43	0.3
04.10.00	11:00	10	0	18	

Table G: 1-h average concentrations at monitoring site BT2.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
02.11.00	00:00	46	59	61	4.9	04.11.00	01:00	61	138	61	7.7
02.11.00	01:00	61	66	63	3.7	04.11.00	02:00	53	54	51	4.1
02.11.00	02:00	60	118	66	4.3	04.11.00	03:00	51	19	46	2.0
02.11.00	03:00	54	57	51	3.9	04.11.00	04:00	48	38	45	3.0
02.11.00	04:00	55	104	55	4.6	04.11.00	05:00	113	197	70	8.6
02.11.00	05:00	84	82	52	5.0	04.11.00	06:00	150	139	78	7.8
02.11.00	06:00	115	100	70	7.3	04.11.00	07:00	111	118	90	12.2
02.11.00	07:00	155	141	101	12.0	04.11.00	08:00	80	119	83	14.6
02.11.00	08:00	78	78	88	12.1	04.11.00	09:00	68	55	85	7.8
02.11.00	09:00	68	44	64	7.6	04.11.00	10:00	64	35	72	6.0
02.11.00	10:00	80	63	78	10.1	04.11.00	11:00	55	23	71	6.4
02.11.00	11:00	62	28	59	6.1	04.11.00	12:00	66	17	61	8.2
02.11.00	12:00	91	45	82	8.4	04.11.00	01:00	43	18	50	5.0
02.11.00	01:00	63	40	82	7.0	04.11.00	02:00	37	19	52	4.6
02.11.00	02:00	55	36	87	7.3	04.11.00	03:00	101	65	90	7.0
02.11.00	03:00	86	104	116	12.8	04.11.00	04:00	246	270	120	13.0
02.11.00	04:00	99	95	110	9.7	04.11.00	05:00	241	360	116	19.3
02.11.00	05:00	106	88	99	7.6	04.11.00	06:00	360	595	145	19.8
02.11.00	06:00	198	173	101	11.4	04.11.00	07:00	129	175	83	12.5
02.11.00	07:00	165	230	103	14.7	04.11.00	08:00	109	113	75	8.7
02.11.00	08:00	213	415	104	16.3	04.11.00	09:00	208	316	84	13.7
02.11.00	09:00	125	157	85	10.0	04.11.00	10:00	211	470	89	18.6
02.11.00	10:00	144	304	82	14.7	04.11.00	11:00	124	215	64	11.4
02.11.00	11:00	119	244	75	11.8	05.11.00	00:00	69	99	57	6.9
03.11.00	00:00	107	269	76	11.6	05.11.00	01:00	64	139	58	8.0
03.11.00	01:00	90	253	71	10.8	05.11.00	02:00	131	268	66	8.7
03.11.00	02:00	58	91	60	5.6	05.11.00	03:00	100	189	59	5.9
03.11.00	03:00	48	80	55	5.0	05.11.00	04:00	51	23	43	2.7
03.11.00	04:00	63	226	57	9.4	05.11.00	05:00	77	73	47	4.7
03.11.00	05:00	82	92	53	5.7	05.11.00	06:00	124	90	65	9.2
03.11.00	06:00	136	215	100	9.6	05.11.00	07:00	209	188	129	11.0
03.11.00	07:00	73	86	80	10.0	05.11.00	08:00	92	101	95	13.3
03.11.00	08:00	56	66	74	9.8	05.11.00	09:00	57	47	73	8.0
03.11.00	09:00	51	74	83	9.8	05.11.00	10:00	45	22	49	5.2
03.11.00	10:00	72	81	97	10.6	05.11.00	11:00	36	23	61	5.9
03.11.00	11:00	40	33	54	8.8	05.11.00	12:00	45	15	55	5.8
03.11.00	12:00	39	28	56	8.3	05.11.00	01:00	53	31	79	6.4
03.11.00	01:00	37	32	64	6.7	05.11.00	02:00	52	31	76	6.4
03.11.00	02:00	45	35	67	6.9	05.11.00	03:00	68	71	107	7.3
03.11.00	03:00	61	55	84	6.4	05.11.00	04:00	95	84	107	8.5
03.11.00	04:00	117	177	101	12.0	05.11.00	05:00	146	169	102	10.1
03.11.00	05:00	187	264	107	13.8	05.11.00	06:00	163	259	102	18.0
03.11.00	06:00	230	460	113	18.3	05.11.00	07:00	196	407	112	16.8
03.11.00	07:00	194	317	100	16.2	05.11.00	08:00	262	575	117	19.6
03.11.00	08:00	137	216	82	14.0	05.11.00	09:00	226	522	109	18.5
03.11.00	09:00	95	163	67	11.5	05.11.00	10:00	84	83	74	6.9
03.11.00	10:00	101	221	71	12.6	05.11.00	11:00	116	171	83	8.8
03.11.00	11:00	105	229	75	12.0	06.11.00	00:00	140	362	93	15.6
04.11.00	00:00	80	230	68	12.6	06.11.00	01:00	78	119	62	6.4

Table G: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
06.11.00	02:00	66	99	56	7.1	08.11.00	03:00	68	83	56	5.2
06.11.00	03:00	64	65	53	6.5	08.11.00	04:00	57	43	49	3.4
06.11.00	04:00	50	40	49	5.0	08.11.00	05:00	88	66	56	4.8
06.11.00	05:00	190	425	117	10.9	08.11.00	06:00	131	115	79	8.8
06.11.00	06:00	216	188	89	9.7	08.11.00	07:00	153	123	97	13.0
06.11.00	07:00	155	99	97	7.6	08.11.00	08:00	90	134	95	17.2
06.11.00	08:00	100	27	89	7.2	08.11.00	09:00	66	90	79	11.5
06.11.00	09:00	87	53	94	9.8	08.11.00	10:00	48	66	64	10.1
06.11.00	10:00	84	34	78	7.3	08.11.00	11:00	56	68	76	8.7
06.11.00	11:00	102	32	69	5.5	08.11.00	12:00	63	75	99	12.4
06.11.00	12:00	90	20	68	7.5	08.11.00	01:00	62	89	90	11.8
06.11.00	01:00	79	33	93	6.0	08.11.00	02:00	63	98	83	10.5
06.11.00	02:00	86	76	115	9.1	08.11.00	03:00	88	138	90	13.1
06.11.00	03:00	119	133	116	13.5	08.11.00	04:00	142	145	90	11.7
06.11.00	04:00	135	150	121	11.3	08.11.00	05:00	131	98	80	9.6
06.11.00	05:00	156	122	117	9.5	08.11.00	06:00	167	115	76	9.3
06.11.00	06:00	196	254	110	19.0	08.11.00	07:00	157	214	83	12.0
06.11.00	07:00	194	332	105	19.8	08.11.00	08:00	155	209	77	11.5
06.11.00	08:00	290	579	121	19.4	08.11.00	09:00	135	130	68	9.1
06.11.00	09:00	285	406	116	16.0	08.11.00	10:00	138	181	75	11.7
06.11.00	10:00	271	511	114	15.8	08.11.00	11:00	137	271	74	15.0
06.11.00	11:00	207	459	102	17.0	09.11.00	00:00	84	136	54	8.0
07.11.00	00:00	131	321	83	14.9	09.11.00	01:00	109	230	64	7.6
07.11.00	01:00	90	149	67	8.1	09.11.00	02:00	135	238	62	6.8
07.11.00	02:00	64	51	56	4.4	09.11.00	03:00	142	309	75	7.0
07.11.00	03:00	92	139	62	4.5	09.11.00	04:00	83	135	50	6.3
07.11.00	04:00	169	399	96	12.1	09.11.00	05:00	101	67	52	3.6
07.11.00	05:00	107	185	72	9.3	09.11.00	06:00	140	122	65	7.3
07.11.00	06:00	146	123	80	7.9	09.11.00	07:00	129	97	89	9.0
07.11.00	07:00	154	117	114	12.2	09.11.00	08:00	92	47	78	10.4
07.11.00	08:00	140	111	130	12.8	09.11.00	09:00	68	56	86	10.0
07.11.00	09:00	64	81	98	11.7	09.11.00	10:00	49	37	74	8.4
07.11.00	10:00	51	41	62	8.4	09.11.00	11:00	48	37	72	7.2
07.11.00	11:00	42	38	62	8.5	09.11.00	12:00	68	46	82	10.4
07.11.00	12:00	55	27	64	8.2	09.11.00	01:00	64	25	60	6.3
07.11.00	01:00	51	41	78	8.0	09.11.00	02:00	71	35	74	7.7
07.11.00	02:00	62	68	95	8.9	09.11.00	03:00	98	94	84	10.1
07.11.00	03:00	90	107	107	10.3	09.11.00	04:00	298	549	127	19.1
07.11.00	04:00	125	114	110	11.5	09.11.00	05:00	396	731	143	20.0
07.11.00	05:00	213	157	109	10.6	09.11.00	06:00	316	523	118	19.9
07.11.00	06:00	255	307	110	17.9	09.11.00	07:00	204	308	90	18.2
07.11.00	07:00	203	266	99	16.7	09.11.00	08:00	194	329	90	19.4
07.11.00	08:00	201	243	96	15.6	09.11.00	09:00	186	247	85	15.7
07.11.00	09:00	185	310	95	16.8	09.11.00	10:00	140	173	72	11.4
07.11.00	10:00	262	617	148	18.6	09.11.00	11:00	107	167	68	11.7
07.11.00	11:00	274	563	115	17.5	10.11.00	00:00	83	139	61	11.5
08.11.00	00:00	196	390	86	15.7	10.11.00	01:00	69	88	54	7.0
08.11.00	01:00	100	140	64	6.2	10.11.00	02:00	51	43	47	5.0
08.11.00	02:00	64	33	53	3.9	10.11.00	03:00	70	118	52	6.1

Table G: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
10.11.00	04:00	100	295	63	10.1
10.11.00	05:00	127	288	73	9.9
10.11.00	06:00	189	259	91	10.2
10.11.00	07:00	132	123	98	10.6
10.11.00	08:00	109	63	144	8.0
10.11.00	09:00	83	37	123	8.8
10.11.00	10:00	68	25	75	7.2
10.11.00	11:00	70	25	69	7.6
10.11.00	12:00	42	21	70	9.9
10.11.00	01:00	37	22	61	6.4
10.11.00	02:00	45	39	71	7.7
10.11.00	03:00	135	243	101	18.7
10.11.00	04:00	239	362	115	17.6
10.11.00	05:00	256	426	111	20.0
10.11.00	06:00	263	444	104	20.0
10.11.00	07:00	225	337	92	19.9
10.11.00	08:00	211	437	103	19.7
10.11.00	09:00	172	274	82	16.1
10.11.00	10:00	162	281	80	14.2
10.11.00	11:00	164	350	78	15.1
11.11.00	00:00	117	196	62	9.0
11.11.00	01:00	63	78	51	5.6
11.11.00	02:00	54	19	46	2.9
11.11.00	03:00	70	55	50	4.1
11.11.00	04:00	124	251	63	7.0
11.11.00	05:00	146	368	82	10.6
11.11.00	06:00	218	178	74	8.3
11.11.00	07:00	179	143	95	13.9
11.11.00	08:00	144	113	101	13.4
11.11.00	09:00	69	84	79	11.1
11.11.00	10:00	63	61	69	8.8
11.11.00	11:00	67	41	59	8.2
11.11.00	12:00	66	46	64	11.6
11.11.00	01:00	85	67	59	7.8
11.11.00	02:00	102	104	70	9.8
11.11.00	03:00	184	173	84	14.2
11.11.00	04:00	203	196	83	11.3
11.11.00	05:00	297	326	93	17.0
11.11.00	06:00	213	191	74	10.7
11.11.00	07:00	221	322	84	13.4
11.11.00	08:00	309	664	102	20.0
11.11.00	09:00	192	375	72	18.2
11.11.00	10:00	145	231	57	14.3
11.11.00	11:00	155	274	67	12.1
12.11.00	00:00	84	177	59	12.3
12.11.00	01:00	96	158	48	7.5
12.11.00	02:00	83	76	42	4.5
12.11.00	03:00	120	286	59	10.7
12.11.00	04:00	113	250	56	9.1
12.11.00	05:00	199	488	94	10.9
12.11.00	06:00	201	240	82	10.1
12.11.00	07:00	181	131	92	10.4
12.11.00	08:00	150	97	101	11.5
12.11.00	09:00	105	63	80	9.2
12.11.00	10:00	75	29	55	6.1
12.11.00	11:00	93	27	67	5.8
12.11.00	12:00	54	23	52	6.4
12.11.00	01:00	51	23	50	5.6
12.11.00	02:00	67	46	63	6.9
12.11.00	03:00	150	216	84	15.4
12.11.00	04:00	236	298	100	14.8
12.11.00	05:00	244	265	93	12.1
12.11.00	06:00	250	427	89	18.7
12.11.00	07:00	213	342	80	18.5
12.11.00	08:00	245	374	81	18.1
12.11.00	09:00	314	603	93	20.0
12.11.00	10:00	184	241	66	12.6
12.11.00	11:00	109	115	56	7.2

Table H: 1-h average concentrations at monitoring site JO2.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3	Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
20.09.00	00:00	31	10	50	0.9	22.09.00	01:00	40	12	83	1.4
20.09.00	01:00	64	60	78	2.8	22.09.00	02:00	52	1	40	0.0
20.09.00	02:00	47	45	71	1.9	22.09.00	03:00	28	1	43	0.1
20.09.00	03:00	36	14	61	0.7	22.09.00	04:00	25	11	54	0.5
20.09.00	04:00	32	9	57	0.3	22.09.00	05:00	48	65	70	2.1
20.09.00	05:00	37	48	60	1.4	22.09.00	06:00	60	97	65	3.1
20.09.00	06:00	80	62	61	1.5	22.09.00	07:00	74	146	91	3.5
20.09.00	07:00	117	148	83	2.8	22.09.00	08:00	92	73	121	3.0
20.09.00	08:00	69	57	77	1.6	22.09.00	09:00	74	8	65	1.0
20.09.00	09:00	44	10	58	0.8	22.09.00	10:00	33	1	22	0.2
20.09.00	10:00	60	6	62	1.0	22.09.00	11:00	19	1	10	
20.09.00	11:00	36	3	28	0.4	22.09.00	12:00	17	2	9	
20.09.00	12:00	28	1	18	0.2	22.09.00	01:00	13	1	7	0.0
20.09.00	01:00	25	2	18	0.0	22.09.00	02:00	13	2	8	0.0
20.09.00	02:00	25	2	22	0.6	22.09.00	03:00	16	2	10	0.3
20.09.00	03:00	22	2	19	0.3	22.09.00	04:00	11	2	10	0.0
20.09.00	04:00	20	2	18	0.4	22.09.00	05:00	13	2	16	0.4
20.09.00	05:00	25	3	34	1.3	22.09.00	06:00	30	11	64	3.4
20.09.00	06:00	52	7	79	4.1	22.09.00	07:00	85	132	108	11.2
20.09.00	07:00	93	51	100	5.3	22.09.00	08:00	77	95	104	6.9
20.09.00	08:00	117	81	104	6.9	22.09.00	09:00	29	6	62	1.4
20.09.00	09:00	88	21	87	2.6	22.09.00	10:00	33	12	84	1.3
20.09.00	10:00	55	14	72	2.1	22.09.00	11:00	26	8	70	0.8
20.09.00	11:00	43	31	66	3.1	23.09.00	00:00	23	4	55	0.4
21.09.00	00:00	79	122	88	5.6	23.09.00	01:00	23	3	63	0.4
21.09.00	01:00	72	133	82	5.5	23.09.00	02:00	23	4	63	0.2
21.09.00	02:00	58	81	74	3.5	23.09.00	03:00	18	1	45	
21.09.00	03:00	50	85	65	3.2	23.09.00	04:00	16	2	41	
21.09.00	04:00	48	87	62	3.1	23.09.00	05:00	29	4	47	
21.09.00	05:00	56	47	61	1.4	23.09.00	06:00	74	51	67	0.8
21.09.00	06:00	67	79	71	0.7	23.09.00	07:00	91	85	83	2.4
21.09.00	07:00	125	146	87	2.4	23.09.00	08:00	87	84	108	2.5
21.09.00	08:00	67	26	69	1.3	23.09.00	09:00	69	17	80	1.3
21.09.00	09:00	56	11	51	0.6	23.09.00	10:00	27	5	30	0.5
21.09.00	10:00	37	3	26	0.3	23.09.00	11:00	25	3	17	0.2
21.09.00	11:00	36	6	22	0.2	23.09.00	12:00	22	3	13	0.1
21.09.00	12:00	25	1	12	0.0	23.09.00	01:00	16	2	12	0.1
21.09.00	01:00	26	1	13	0.0	23.09.00	02:00	13	2	12	0.2
21.09.00	02:00	29	2	13	0.2	23.09.00	03:00	12	3	11	0.1
21.09.00	03:00	31	2	11	0.0	23.09.00	04:00	12	2	12	0.1
21.09.00	04:00	28	2	16	0.2	23.09.00	05:00	16	2	21	0.4
21.09.00	05:00	34	6	38	1.3	23.09.00	06:00	42	16	78	5.7
21.09.00	06:00	54	14	81	5.4	23.09.00	07:00	32	14	72	2.8
21.09.00	07:00	102	128	101	12.6	23.09.00	08:00	30	1	36	0.7
21.09.00	08:00	113	48	92	4.6	23.09.00	09:00	65	4	69	1.5
21.09.00	09:00	43	14	71	2.8	23.09.00	10:00	44	16	83	2.7
21.09.00	10:00	55	19	82	3.1	23.09.00	11:00	35	19	64	2.2
21.09.00	11:00	75	62	89	3.8	24.09.00	00:00	44	31	81	3.5
22.09.00	00:00	56	43	90	2.8	24.09.00	01:00	49	84	83	3.3

Table H: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
24.09.00	02:00	27	0	49	0.0
24.09.00	03:00	39	17	67	
24.09.00	04:00	30	27	59	
24.09.00	05:00	40	15	52	0.0
24.09.00	06:00	47	15	50	0.2
24.09.00	07:00	78	51	60	1.5
24.09.00	08:00	138	83	98	2.8
24.09.00	09:00	136	46	130	2.8
24.09.00	10:00	84	10	89	1.7
24.09.00	11:00	56	4	48	0.8
24.09.00	12:00	20	2	19	0.3
24.09.00	01:00	16	2	13	0.3
24.09.00	02:00	18	2	16	0.0
24.09.00	03:00	17	2	19	0.3
24.09.00	04:00	17	2	20	0.4
24.09.00	05:00	18	3	36	1.2
24.09.00	06:00	22	2	40	0.9
24.09.00	07:00	14	2	34	0.4
24.09.00	08:00	12	3	41	1.1
24.09.00	09:00	17	2	44	0.8
24.09.00	10:00	62	9	63	1.6
24.09.00	11:00	48	49	82	2.5
25.09.00	00:00	75	113	87	5.2
25.09.00	01:00	48	26	59	1.0
25.09.00	02:00	100	3	42	
25.09.00	03:00	37	1	32	
25.09.00	04:00	27	5	46	
25.09.00	05:00	85	12	53	
25.09.00	06:00	51	15	52	
25.09.00	07:00	60	33	49	0.5
25.09.00	08:00	88	44	61	1.4
25.09.00	09:00	68	24	70	1.4
25.09.00	10:00	77	13	71	1.1
25.09.00	11:00	64	5	55	0.9
25.09.00	12:00	38	3	32	0.2
25.09.00	01:00	22	3	20	0.4
25.09.00	02:00	20	2	16	0.1
25.09.00	03:00	13	2	14	0.0
25.09.00	04:00	9	2	14	
25.09.00	05:00	8	2	16	0.0
25.09.00	06:00	7	1	18	
25.09.00	07:00	8	2	25	0.0
25.09.00	08:00	6	1	25	0.2
25.09.00	09:00	7	3	25	0.2
25.09.00	10:00	10	2	24	0.1
25.09.00	11:00	28	2	27	0.1
26.09.00	00:00	29	6	42	0.6
26.09.00	01:00	32	16	52	0.7
26.09.00	02:00	24	13	40	0.1
26.09.00	03:00	15	6	32	
26.09.00	04:00	16	2	28	
26.09.00	05:00	14	26	42	
26.09.00	06:00	20	18	41	
26.09.00	07:00	40	49	45	0.4
26.09.00	08:00	51	29	50	0.8
26.09.00	09:00	63	20	64	1.1
26.09.00	10:00	63	11	58	0.7
26.09.00	11:00	36	5	27	0.4
26.09.00	12:00	20	2	12	
26.09.00	01:00	17	2	12	0.1
26.09.00	02:00	16	2	16	0.1
26.09.00	03:00	15	3	16	0.0
26.09.00	04:00	17	3	19	0.1
26.09.00	05:00	12	2	20	0.1
26.09.00	06:00	8	2	28	0.1
26.09.00	07:00	8	2	32	0.5
26.09.00	08:00	15	3	52	1.3
26.09.00	09:00	18	4	48	1.1
26.09.00	10:00	17	4	55	1.2
26.09.00	11:00	10	2	37	0.5

Table I: 1-h average concentrations at monitoring site MJ2.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3	Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
06.10.00	00:00	12	24	28	0.6	08.10.00	01:00	36	25	60	1.0
06.10.00	01:00	30	63	63	2.3	08.10.00	02:00	28	25	52	1.1
06.10.00	02:00	19	30	39	1.1	08.10.00	03:00	20	9	36	0.2
06.10.00	03:00	4	10	11		08.10.00	04:00	18	15	39	0.4
06.10.00	04:00	6	4	11		08.10.00	05:00	76	55	60	1.7
06.10.00	05:00	10	10	18		08.10.00	06:00	136	82	82	3.3
06.10.00	06:00	38	23	36	0.4	08.10.00	07:00	158	118	121	6.5
06.10.00	07:00	63	40	61	2.4	08.10.00	08:00	132	57	116	4.4
06.10.00	08:00	86	32	72	1.6	08.10.00	09:00	96	44	68	3.0
06.10.00	09:00	48	25	45	1.3	08.10.00	10:00	73	26	62	2.3
06.10.00	10:00	65	37	55	1.2	08.10.00	11:00	110	42	81	3.1
06.10.00	11:00	51	30	50	1.9	08.10.00	12:00	93	30	88	3.6
06.10.00	12:00	59	36	60	2.9	08.10.00	01:00	41	23	27	1.0
06.10.00	01:00	66	43	75	2.6	08.10.00	02:00	30	16	27	0.8
06.10.00	02:00	67	52	76	3.0	08.10.00	03:00	26	13	23	0.4
06.10.00	03:00	62	45	79	3.2	08.10.00	04:00	28	16	21	0.4
06.10.00	04:00	46	34	59	2.8	08.10.00	05:00	28	18	23	0.6
06.10.00	05:00	50	48	53	2.4	08.10.00	06:00	36	29	29	1.4
06.10.00	06:00	68	74	73	4.0	08.10.00	07:00	88	108	72	7.5
06.10.00	07:00	59	55	50	2.9	08.10.00	08:00	158	217	79	11.3
06.10.00	08:00	88	156	80	6.6	08.10.00	09:00	135	187	73	10.0
06.10.00	09:00	42	38	46	1.8	08.10.00	10:00	110	174	66	7.6
06.10.00	10:00	35	32	47	1.2	08.10.00	11:00	58	135	56	5.3
06.10.00	11:00	21	21	33	0.4	09.10.00	00:00	65	144	56	4.9
07.10.00	00:00	8	7	16	0.1	09.10.00	01:00	56	40	54	1.4
07.10.00	01:00	7	2	6	0.0	09.10.00	02:00	31	12	42	0.5
07.10.00	02:00	10	2	16	0.0	09.10.00	03:00	36	22	44	0.7
07.10.00	03:00	11	10	22	0.1	09.10.00	04:00	35	34	44	0.9
07.10.00	04:00	17	19	30	0.2	09.10.00	05:00	98	89	53	2.7
07.10.00	05:00	111	115	78	2.5	09.10.00	06:00	162	143	84	5.3
07.10.00	06:00	208	182	136	5.5	09.10.00	07:00	175	127	113	6.4
07.10.00	07:00	157	109	105	5.4	09.10.00	08:00	136	63	116	4.2
07.10.00	08:00	163	75	142	4.7	09.10.00	09:00	102	42	68	3.0
07.10.00	09:00	97	52	95	3.0	09.10.00	10:00	59	33	39	2.2
07.10.00	10:00	69	27	59	1.9	09.10.00	11:00	74	44	46	2.3
07.10.00	11:00	71	33	65	2.0	09.10.00	12:00	108	75	62	3.4
07.10.00	12:00	61	39	56	2.4	09.10.00	01:00	99	61	58	4.0
07.10.00	01:00	83	58	58	3.1	09.10.00	02:00	84	59	65	4.1
07.10.00	02:00	72	46	63	3.9	09.10.00	03:00	97	73	71	3.8
07.10.00	03:00	73	52	79	3.4	09.10.00	04:00	90	68	70	4.5
07.10.00	04:00	69	36	76	3.0	09.10.00	05:00	68	45	55	3.0
07.10.00	05:00	51	24	56	2.3	09.10.00	06:00	63	54	59	3.7
07.10.00	06:00	64	29	46	2.2	09.10.00	07:00	69	57	41	2.8
07.10.00	07:00	73	34	60	2.8	09.10.00	08:00	27	23	27	1.5
07.10.00	08:00	108	122	85	7.7	09.10.00	09:00	82	107	63	5.4
07.10.00	09:00	159	253	113	13.1	09.10.00	10:00	74	80	56	3.6
07.10.00	10:00	107	172	93	8.5	09.10.00	11:00	62	97	65	3.8
07.10.00	11:00	86	158	76	6.6	10.10.00	00:00	69	111	59	4.4
08.10.00	00:00	41	49	62	1.9	10.10.00	01:00	41	31	36	1.1

Table I: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
10.10.00	02:00	15	7	10	0.0	12.10.00	03:00	24	12	36	0.2
10.10.00	03:00	20	10	17	0.0	12.10.00	04:00	27	16	34	0.6
10.10.00	04:00	18	15	25	0.2	12.10.00	05:00	24	13	24	0.1
10.10.00	05:00	119	74	75	1.8	12.10.00	06:00	89	66	56	2.6
10.10.00	06:00	147	103	66	4.0	12.10.00	07:00	80	53	47	2.8
10.10.00	07:00	145	86	95	4.2	12.10.00	08:00	77	38	45	2.3
10.10.00	08:00	102	49	66	2.9	12.10.00	09:00	68	34	44	1.9
10.10.00	09:00	78	41	53	1.9	12.10.00	10:00	66	35	47	2.1
10.10.00	10:00	73	30	60	2.4	12.10.00	11:00	57	25	42	3.1
10.10.00	11:00	72	23	52	1.8	12.10.00	12:00	77	38	56	2.9
10.10.00	12:00	48	20	37	1.1	12.10.00	01:00	97	72	74	4.3
10.10.00	01:00	36	16	25	0.9	12.10.00	02:00	93	63	83	4.6
10.10.00	02:00	29	13	22	0.9	12.10.00	03:00	80	67	70	3.2
10.10.00	03:00	21	8	14	0.1	12.10.00	04:00	67	41	57	2.9
10.10.00	04:00	22	14	19	0.2	12.10.00	05:00	46	29	38	1.4
10.10.00	05:00	20	11	16	0.4	12.10.00	06:00	61	44	50	3.2
10.10.00	06:00	23	15	17	0.6	12.10.00	07:00	140	174	87	8.0
10.10.00	07:00	28	17	17	0.7	12.10.00	08:00	100	177	81	9.9
10.10.00	08:00	30	22	18	0.9	12.10.00	09:00	41	37	44	1.8
10.10.00	09:00	17	12	12	0.1	12.10.00	10:00	36	46	48	2.0
10.10.00	10:00	15	12	13	0.1	12.10.00	11:00	38	38	43	2.3
10.10.00	11:00	9	10	13	0.1	13.10.00	00:00	18	21	26	0.7
11.10.00	00:00	8	5	6		13.10.00	01:00	25	91	50	3.1
11.10.00	01:00	5	3	1		13.10.00	02:00	64	130	64	4.7
11.10.00	02:00	3	1			13.10.00	03:00	40	84	60	3.6
11.10.00	03:00	6	1	1		13.10.00	04:00	30	46	44	2.2
11.10.00	04:00	7	1	4		13.10.00	05:00	44	22	41	0.8
11.10.00	05:00	15	6	7		13.10.00	06:00	66	33	54	1.4
11.10.00	06:00	32	17	28	0.9	13.10.00	07:00	73	41	62	1.8
11.10.00	07:00	20	9	12	0.5	13.10.00	08:00	41	21	28	1.1
11.10.00	08:00	23	10	16	0.4	13.10.00	09:00	37	20	25	1.6
11.10.00	09:00	25	12	17	0.5	13.10.00	10:00	44	24	31	1.6
11.10.00	10:00	23	9	13	0.2	13.10.00	11:00	41	25	26	1.5
11.10.00	11:00	22	10	13	0.2	13.10.00	12:00	59	41	38	2.7
11.10.00	12:00	35	15	23	0.7	13.10.00	01:00	41	37	34	2.4
11.10.00	01:00	25	16	21	0.6	13.10.00	02:00	37	38	39	2.6
11.10.00	02:00	27	13	20	0.5	13.10.00	03:00	39	36	45	2.8
11.10.00	03:00	20	16	22	0.9	13.10.00	04:00	40	39	46	3.1
11.10.00	04:00	24	14	24	0.6	13.10.00	05:00	44	46	48	3.5
11.10.00	05:00	18	12	20	0.2	13.10.00	06:00	58	38	42	3.2
11.10.00	06:00	24	13	18	0.5	13.10.00	07:00	45	32	34	2.8
11.10.00	07:00	26	15	21	0.6	13.10.00	08:00	31	26	34	1.8
11.10.00	08:00	33	24	26	1.2	13.10.00	09:00	24	22	29	1.6
11.10.00	09:00	75	92	71	3.7	13.10.00	10:00	20	23	26	1.0
11.10.00	10:00	89	143	75	5.8	13.10.00	11:00	17	23	28	1.2
11.10.00	11:00	75	95	71	3.4						
12.10.00	00:00	52	53	54	2.3						
12.10.00	01:00	41	41	56	1.9						
12.10.00	02:00	55	39	50	1.4						

Table J: 1-h average concentrations at monitoring site MJ3.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
26.10.00	00:00	14	16	32	1.4	28.10.00	05:00	65	38	52	2.5
26.10.00	01:00	14	17	37	1.6	28.10.00	06:00	97	75	53	3.1
26.10.00	02:00	11	8	28	1.3	28.10.00	07:00	78	64	60	3.7
26.10.00	03:00	11	3	13	0.8	28.10.00	08:00	86	58	97	3.3
26.10.00	04:00	18	14	26	1.3	28.10.00	09:00	66	24	67	2.5
26.10.00	05:00	38	38	34	2.2	28.10.00	10:00	39	20	46	1.9
26.10.00	06:00	96	95	47	3.3	28.10.00	11:00	33	19	40	1.6
26.10.00	07:00	74	81	42	2.8	28.10.00	12:00	37	22	43	1.8
26.10.00	08:00	72	34	56	2.7	28.10.00	01:00	38	36	54	2.3
26.10.00	09:00	98	48	91	3.9	28.10.00	02:00	38	23	52	1.5
26.10.00	10:00	50	30	55	2.6	28.10.00	03:00	52	40	65	2.5
26.10.00	11:00	35	22	36	1.9	28.10.00	04:00	106	78	84	4.2
26.10.00	12:00	37	21	30	1.6	28.10.00	05:00	153	179	104	7.1
26.10.00	01:00	38	30	39	2.0	28.10.00	06:00	176	210	109	9.4
26.10.00	02:00	43	24	44	2.0	28.10.00	07:00	60	68	75	3.5
26.10.00	03:00	84	20	64	2.5	28.10.00	08:00	84	112	87	5.0
26.10.00	04:00	77	18	58	2.1	28.10.00	09:00	176	355	104	14.1
26.10.00	05:00	83	26	61	2.1	28.10.00	10:00	181	336	99	13.9
26.10.00	06:00	63	21	51	2.1	28.10.00	11:00	40	54	66	3.3
26.10.00	07:00	75	82	67	4.5	29.10.00	00:00	33	55	54	2.8
26.10.00	08:00	102	155	79	7.6	29.10.00	01:00	33	28	59	2.3
26.10.00	09:00	104	97	74	5.9	29.10.00	02:00	24	10	41	1.3
26.10.00	10:00	43	58	58	3.2	29.10.00	03:00	27	12	38	1.4
26.10.00	11:00	56	72	66	4.2	29.10.00	04:00	38	14	44	1.3
27.10.00	00:00	80	128	64	6.0	29.10.00	05:00	48	26	37	1.4
27.10.00	01:00	52	107	53	4.9	29.10.00	06:00	53	33	38	1.5
27.10.00	02:00	31	64	48	3.1	29.10.00	07:00	65	58	59	2.9
27.10.00	03:00	40	55	48	2.8	29.10.00	08:00	81	65	79	3.4
27.10.00	08:00	150			1.5	29.10.00	09:00	86	24	82	3.1
27.10.00	09:00	56	15	52	1.5	29.10.00	10:00	61	23	65	2.7
27.10.00	10:00	32	7	25	1.2	29.10.00	11:00	49	30	54	2.1
27.10.00	11:00	28	12	28	1.5	29.10.00	12:00	36	21	46	1.9
27.10.00	12:00	26	18	33	1.7	29.10.00	01:00	42	44	49	2.6
27.10.00	01:00	28	18	36	1.9	29.10.00	02:00	64	78	73	3.5
27.10.00	02:00	24	4	25	1.2	29.10.00	03:00	79	92	80	3.8
27.10.00	03:00	39	5	38	1.6	29.10.00	04:00	72	52	63	2.9
27.10.00	04:00	50	20	54	2.3	29.10.00	05:00	229	188	98	8.3
27.10.00	05:00	53	44	56	2.9	29.10.00	06:00	110	105	85	5.4
27.10.00	06:00	28	14	44	1.8	29.10.00	07:00	144	227	98	8.7
27.10.00	07:00	62	77	59	3.5	29.10.00	08:00	151	185	99	9.3
27.10.00	08:00	107	161	83	7.5	29.10.00	09:00	78	99	73	5.0
27.10.00	09:00	101	145	73	6.7	29.10.00	10:00	108	240	82	8.8
27.10.00	10:00	55	82	63	4.2	29.10.00	11:00	113	220	78	9.0
27.10.00	11:00	43	96	55	4.4	30.10.00	00:00	110	246	73	9.8
28.10.00	00:00	20	23	41	1.6	30.10.00	01:00	28	18	41	1.4
28.10.00	01:00	12	3	13	0.7	30.10.00	02:00	19	8	27	1.1
28.10.00	02:00	10	0	6	0.5	30.10.00	03:00	15	3	17	0.6
28.10.00	03:00	18	5	24	0.8	30.10.00	04:00	29	11	34	1.3
28.10.00	04:00	38	23	36	1.3	30.10.00	05:00	65	46	41	1.5

Table J: continued.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
30.10.00	06:00	116	79	61	2.9
30.10.00	07:00	145	98	98	4.5
30.10.00	08:00	143	55	128	4.7
30.10.00	09:00	77	22	77	2.9
30.10.00	10:00	66	21	67	2.5
30.10.00	11:00	57	14	49	1.8
30.10.00	12:00	45	29	55	2.5
30.10.00	01:00	42	37	46	2.6
30.10.00	02:00	51	38	57	2.4
30.10.00	03:00	37	25	43	1.8
30.10.00	04:00	35	19	41	1.7
30.10.00	05:00	24	11	31	1.3
30.10.00	06:00	21	7	21	1.0
30.10.00	07:00	16	10	22	1.2
30.10.00	08:00	15	10	27	1.3
30.10.00	09:00	27	11	33	1.5
30.10.00	10:00	20	7	25	1.2
30.10.00	11:00	13	2	12	0.7
31.10.00	00:00	14	4	17	0.6
31.10.00	01:00	44	71	51	3.3
31.10.00	02:00	37	53	52	2.8
31.10.00	03:00	34	30	48	1.7
31.10.00	04:00	38	41	45	1.9
31.10.00	05:00	83	66	47	2.5
31.10.00	06:00	124	114	59	3.6
31.10.00	07:00	84	81	64	3.7
31.10.00	08:00	72	33	70	3.0
31.10.00	09:00	59	22	59	2.6

Table K: 1-h average concentrations at monitoring site BSH.

Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³	Date	Hour	SO_2 µg/m³	NO µg/m³	NO_2 µg/m³	CO mg/m³
11.09.00	00:00	38	13	61	1.0	13.09.00	01:00	6	1	16	
11.09.00	01:00	27	7	51	0.6	13.09.00	02:00	7	1	16	
11.09.00	02:00	35	6	48	0.4	13.09.00	03:00	5	1	7	
11.09.00	03:00	45	20	63	0.6	13.09.00	04:00	4	1	0	
11.09.00	04:00	36	10	49	0.3	13.09.00	05:00	4	1	3	
11.09.00	05:00	25	5	35		13.09.00	06:00	11	3	16	
11.09.00	06:00	46	21	54	0.8	13.09.00	07:00	28	8	34	0.2
11.09.00	07:00	48	17	48	0.9	13.09.00	08:00	17	4	17	0.1
11.09.00	08:00	40	19	50	1.0	13.09.00	09:00	12	3	13	0.0
11.09.00	09:00	47	19	61	1.2	13.09.00	10:00	10	4	12	0.2
11.09.00	10:00	58	11	59	1.7	13.09.00	11:00	12	5	15	0.0
11.09.00	11:00	50	4	46	0.7	13.09.00	12:00	12	4	12	0.0
11.09.00	12:00	26	2	27	0.3	13.09.00	01:00	9	3	10	0.0
11.09.00	01:00	31	3	30	0.5	13.09.00	02:00	9	3	10	0.1
11.09.00	02:00	28	3	34	0.5	13.09.00	03:00	7	2	8	0.0
11.09.00	03:00	23	4	26	0.4	13.09.00	04:00	7	2	9	0.0
11.09.00	04:00	21	3	23	0.2	13.09.00	05:00	8	2	13	0.2
11.09.00	05:00	30	3	41	0.7	13.09.00	06:00	8	1	16	0.3
11.09.00	06:00	46	5	78	2.0	13.09.00	07:00	18	2	24	0.5
11.09.00	07:00	37	8	79	1.7	13.09.00	08:00	31	8	38	1.3
11.09.00	08:00	53	18	93	2.6	13.09.00	09:00	32	6	41	1.5
11.09.00	09:00	33	5	62	1.2	13.09.00	10:00	13	1	31	0.3
11.09.00	10:00	14	1	38	0.9	13.09.00	11:00	20	5	40	1.0
11.09.00	11:00	14	2	38	0.8	14.09.00	00:00	27	11	40	0.8
12.09.00	00:00	11	1	29	0.3	14.09.00	01:00	28	9	37	0.3
12.09.00	01:00	8	1	18	0.1	14.09.00	02:00	21	4	27	0.2
12.09.00	02:00	7	1	11		14.09.00	03:00	30	11	38	0.1
12.09.00	03:00	6	1	8		14.09.00	04:00	12	1	16	
12.09.00	04:00	6	1	7		14.09.00	05:00	36	5	34	
12.09.00	05:00	8	1	14		14.09.00	06:00	37	6	37	
12.09.00	06:00	8	1	12		14.09.00	07:00	53	19	46	
12.09.00	07:00	21	8	30	0.3	14.09.00	08:00	48	12	28	0.2
12.09.00	08:00	29	11	36	0.4	14.09.00	09:00	38	9	31	1.2
12.09.00	09:00	57	15	53	0.7	14.09.00	10:00	39	9	41	0.6
12.09.00	10:00	58	8	44	0.8	14.09.00	11:00	30	4	22	0.1
12.09.00	11:00	36	4	33	1.1	14.09.00	12:00	20	3	15	0.0
12.09.00	12:00	40	4	42	0.6	14.09.00	01:00	28	5	19	0.0
12.09.00	01:00	47	3	41	0.7	14.09.00	02:00	14	3	13	
12.09.00	02:00	16	5	19	0.2	14.09.00	03:00	19	5	24	0.2
12.09.00	03:00	15	5	19	0.2	14.09.00	04:00	20	5	22	0.0
12.09.00	04:00	10	3	14	0.0	14.09.00	05:00	14	3	26	0.2
12.09.00	05:00	8	5	15	0.1	14.09.00	06:00	18	2	35	0.5
12.09.00	06:00	8	2	17	0.3	14.09.00	07:00	14	1	30	0.4
12.09.00	07:00	8	1	20	0.4	14.09.00	08:00	20	1	29	0.7
12.09.00	08:00	8	2	19	0.4	14.09.00	09:00	12	1	33	0.9
12.09.00	09:00	7	2	25	0.6	14.09.00	10:00	11	1	33	0.6
12.09.00	10:00	12	5	38	0.6	14.09.00	11:00	10	1	39	0.5
12.09.00	11:00	22	14	43	0.6	15.09.00	00:00	42	31	74	1.7
13.09.00	00:00	12	4	29	0.2	15.09.00	01:00	41	20	69	1.1

Table K: continued.

Date	Hour	SO_2 µg/m^3	NO µg/m^3	NO_2 µg/m^3	CO mg/m^3
15.09.00	02:00	30	10	58	0.4
15.09.00	03:00	30	7	49	
15.09.00	04:00	14	1	25	
15.09.00	05:00	10	1	17	
15.09.00	06:00	19	6	30	
15.09.00	07:00	20	6	31	0.1
15.09.00	08:00	19	5	21	0.0
15.09.00	09:00	21	4	23	0.1
15.09.00	10:00	33	6	39	0.6
15.09.00	11:00	17	2	18	0.2
15.09.00	12:00	16	2	14	0.1
15.09.00	01:00	12	2	10	
15.09.00	02:00	12	2	11	
15.09.00	03:00	8	2	10	
15.09.00	04:00	10	2	8	
15.09.00	05:00	14	2	16	0.0
15.09.00	06:00	15	2	24	0.1
15.09.00	07:00	27	6	56	1.1
15.09.00	08:00	45	22	82	2.6
15.09.00	09:00	35	18	73	1.9
15.09.00	10:00	52	48	76	3.0
15.09.00	11:00	40	15	65	1.6
16.09.00	00:00	66	111	72	4.5
16.09.00	01:00	48	123	68	5.2
16.09.00	02:00	34	90	63	3.8
16.09.00	03:00	33	38	60	1.6
16.09.00	04:00	62	52	64	1.0
16.09.00	05:00	54	33	60	0.6
16.09.00	06:00	53	40	62	0.5
16.09.00	07:00	77	41	66	0.9
16.09.00	08:00	89	60	90	2.4
16.09.00	09:00	93	37	127	3.4
16.09.00	10:00	132	18	135	2.8
16.09.00	11:00	94	6	93	2.1
16.09.00	12:00	45	3	49	0.8
16.09.00	01:00	30	2	24	0.0
16.09.00	02:00	32	2	30	0.4
16.09.00	03:00	46	7	53	0.6
16.09.00	04:00	32	3	40	0.5
16.09.00	05:00	41	6	59	0.6
16.09.00	06:00	50	6	75	1.3
16.09.00	07:00	38	10	71	1.6
16.09.00	08:00	31	9	65	1.5
16.09.00	09:00	57	12	60	1.7
16.09.00	10:00	57	46	74	3.8
16.09.00	11:00	68	43	65	1.8
17.09.00	00:00	21	2	29	0.1
17.09.00	01:00	42	11	50	0.5
17.09.00	02:00	13	1	13	
17.09.00	03:00	10	0	9	
17.09.00	04:00	12	1	14	
17.09.00	05:00	27	7	30	
17.09.00	06:00	44	21	43	0.1
17.09.00	07:00	58	31	45	0.7
17.09.00	08:00	69	18	39	0.6
17.09.00	09:00	40	9	29	0.6
17.09.00	10:00	27	5	23	0.3
17.09.00	11:00	22	4	21	0.4
17.09.00	12:00	23	4	17	0.1
17.09.00	01:00	19	2	12	0.0
17.09.00	02:00	22	3	15	0.0
17.09.00	03:00	26	3	20	0.2
17.09.00	04:00	21	2	22	0.1
17.09.00	05:00	32	4	43	0.5
17.09.00	06:00	28	4	49	1.4
17.09.00	07:00	27	4	56	1.7
17.09.00	08:00	41	20	62	2.2
17.09.00	09:00	63	36	71	2.4
17.09.00	10:00	67	24	65	2.2
17.09.00	11:00	34	16	54	1.4
18.09.00	00:00	50	27	55	1.5
18.09.00	01:00	27	13	40	0.4
18.09.00	02:00	28	8	35	0.0
18.09.00	03:00	43	33	40	0.2
18.09.00	04:00	48	40	54	0.2
18.09.00	05:00	46	37	52	0.3
18.09.00	06:00	80	79	55	0.9
18.09.00	07:00	139	131	67	2.0
18.09.00	08:00	105	69	69	2.1
18.09.00	09:00	132	33	80	2.1
18.09.00	10:00	70	12	56	1.4
18.09.00	11:00	21	4	19	0.2
18.09.00	12:00	36	5	23	0.3
18.09.00	01:00	34	6	25	0.1
18.09.00	02:00	18	3	18	0.0
18.09.00	03:00	19	3	20	0.1
18.09.00	04:00	28	6	38	0.2
18.09.00	05:00	31	5	38	0.2
18.09.00	06:00	21	2	30	0.4
18.09.00	07:00	22	1	39	0.8
18.09.00	08:00	33	4	67	2.1
18.09.00	09:00	37	33	81	3.6
18.09.00	10:00	57	97	82	5.7
18.09.00	11:00	46	100	77	6.1