

European Topic Centre on Air Quality

**REQUIREMENTS ON EUROPEAN AIR
QUALITY MONITORING INFORMATION**

by

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SUMMARY

In the framework of the Work Programme of the European Environment Agency, needs and requirements for air quality monitoring in Europe are reviewed in this report. Four major sources for this information are discussed:

- EC legislation in the field of air quality
- international conventions and agreements related to air quality
- European assessment reports and assessment frameworks
- requirements and needs from European states

A questionnaire has been sent to 38 European states; responses from 20 states, 14 EEA member countries and 6 other European countries, are reported and summarised.

Monitoring air quality is an important tool for obtaining information in support of policy development and implementation, and air quality management. For this support to be effective, assessment of air quality should address air quality in relation to sources and human activities, and to impacts and effects on human health and ecosystems. This generally involves more than measured information.

It is concluded, that assessments of air quality, in this meaning, should be a guiding principle for prioritising and restructuring air quality monitoring efforts.

1. INTRODUCTION

1.1 Goal and scope of the report

Collection, interpretation and dissemination of objective, reliable and comparable information on the environment to policy-makers, the general public and others is the central task of the European Environment Agency (EEA). Monitoring is one of the important tools to achieve this.

In the Multi-annual Work Programme 1994-1999 of the Agency (EEA, 1994a), project MA1, entitled "Air Quality, General approach to assessment", has been formulated. The objective of this project, to be carried out by the EEA European Topic Centre on Air Quality, is to establish a first evaluation and a general approach to improve air quality monitoring. In the Annual Work Programme mid-1994-1995 (EEA, 1994b), one of the tasks to fulfil this objective is formulated as to "collect information on requirements for monitoring information". The results of this effort are reported here. This internal report is primarily meant for discussion among EEA, the Commission of the European Communities (particularly DGXI and DGXII), the EEA National Focal Points, and other relevant institutions that form elements of the EEA Environment Information and Observation Network (EIONET). This report also serves as a basis for the final report of project MA1, on recommendations for an assessment approach to be adopted at the European level. Another major element for this final report will be a report on the state of the situation - problems and trends, in which current monitoring practices and availability of necessary information will be reviewed.

In a related project in the Work Programme, coded MA2, a more detailed evaluation on European monitoring and information systems will result in detailed recommendations by the end of 1995. Requirements for modelling and the present situation will be evaluated in project MA3.

The review presented here has been carried out along four lines, as reported in the following chapters:

- the legal and regulatory requirements in the European Union (chapter 2);
- requirements from international conventions of which the European Community or the European states individually are party (chapter 3);
- the monitoring information as used in European assessment reports (chapter 4);
- requirements and needs within the European states (chapter 5).

The last line has been explored by sending a questionnaire (annex 1) to 38 European countries.

The review concentrates on air quality monitoring requirements formulated as:

- compounds or compound groups
- quantity (concentration, deposition, exposure)
- averaging time/time resolution
- spatial density

- representativity for global/continental/local/industrial/urban scale
- accuracy and precision
- availability (real time or delayed)
- products/functions for which the information is needed

The review is preceded by a short introduction summarising a definition, as well as objectives and functions, of air quality monitoring.

1.2 Objectives and functions of air quality monitoring

Air quality monitoring may be defined as the systematic collection of information, for a variety of purposes, from measurements or other means to determine the levels and the time evolution of quantities relevant to air quality, and the reporting of these quantities. Such quantities are air concentrations, fluxes of air pollution to land and water surfaces, and the exposure to air pollution of human beings, materials and ecosystems.

The objective of air quality monitoring is to provide relevant information to governments, enterprises and the public for a range of purposes and applications connected to air quality assessment and air quality management.

Functions of monitoring and applications of monitoring results may be manifold:

- Regulatory: monitoring as part of legal or regulatory obligations, often derived from more general objectives, such as protecting human health, or ecosystems.
- Compliance monitoring: monitoring to verify the achievement of goals formulated in international conventions and other agreements.
- Policy support: monitoring as a means to provide information and to produce assessments in support of the development, formulation, implementation and evaluation of environmental policies.
- Impact assessment: monitoring to determine exposure to air pollution and the resulting impacts and effects on human health, ecosystems, materials, and other environmental compartments.
- Public information and alert: monitoring to provide factual reporting to the public, for information and as a basis for avoiding excessive exposure to air pollution.
- Scientific research: monitoring to answer scientific questions, to elucidate atmospheric processes, and to verify and validate atmospheric models.

The requirements for monitoring with regard to spatial and temporal representativity and accuracy may differ considerably depending on these functions.

Air quality monitoring is only one aspect of air pollution monitoring, a process that should also systematically collect information on air pollution emissions, on human activities causing those emissions, and on the implementation of policy measures directed to those emissions.

The aim of air quality monitoring is to get an estimate of the quantities required (concentrations, fluxes or exposures) with a specified representativity in time and space and a specified accuracy. Spatial scales may include global, continental, national, urban or local

scales; time scales range from trends during decades to minutes of peak concentrations. Accuracy requirements may range from order of magnitude estimates to accuracy better than few percents.

Determining the relevant quantities requires systematic information, obtained by a pre-defined information collection strategy, derived from the specific requirements. Interpretation and evaluation of the data is necessary to evaluate the required quantities and to verify that the requirements are met. Reporting is an essential element of monitoring; without reporting, the functions or applications cannot be achieved.

Although measurements form an important aspect of monitoring, measurements alone are rarely sufficient to arrive at the best possible description of the desired concentrations and other quantities. Air pollution models are often used to interpolate and generalise measured information, or to generate best estimates in situations where measurements are lacking or cannot be made. Models are necessary if the contributions to air quality of sources or source groups are to be quantified.

2. MONITORING REQUIREMENTS IN CEC DIRECTIVES AND DECISIONS

2.1 Introduction

The relevant CEC Council Directives in force now (December 1995) are:

- Council Directive 80/779/EEC, amended by Directive 89/427/EEC, on air quality limit values for sulphur dioxide and suspended particulates;
- Council Directive 82/884/EEC on a limit value for lead;
- Council Directive 85/203/EEC on air quality standards for NO₂;
- Council Directive 92/72/EEC on air pollution by ozone.

Not in force any more (revision under preparation, vide infra) is:

- Council Decision 82/459 (superseding 75/441) on exchange of information on air pollution.

Council Directives and Decisions under preparation are:

- proposed Council Directive on Ambient Air Quality Assessment and Management (Framework Directive on Ambient Air Quality), COM(94) 109 final;
- proposed Council Decision on Exchange of Information on Air Pollution.

2.2 Council Directive 80/779EEC, amended by 89/427/EEC (Sulphur dioxide and suspended particulates)

This Directive sets limit values and guide values for sulphur dioxide and suspended particulates (medians, 98 percentiles and arithmetic means of daily mean concentrations).

Averaging time of the measurements is 24 h, time resolution 24 h.

Measurements should be carried out in particular in zones where limit values are approached or exceeded, and stations should be placed where the highest concentrations are expected.

There are no specific requirements on spatial resolution or area coverage of the measurements; in principle, full coverage is required as all exceedance should be detected. Specified reference methods (or methods demonstrated to produce equivalent and comparable results) are prescribed. No requirements on accuracy or precision are specified. Exceedance of the limit values and of the concentrations recorded should be reported within 6 months of the annual reference period.

2.3 Council Directive 82/884/EEC (Lead)

This Directive defines a limit value for lead (expressed as an annual mean concentration). Averaging time of the measurements is 1-7 days; continuous measurements are not required.

Measurements should be carried out at places where individuals may be exposed continuously for a long period and the limit value is exceeded.

There are no specific requirements on spatial resolution or area coverage of the measurements; in principle, full coverage is required as all exceedance should be detected.

The sampling procedure should meet criteria formulated in an Annex of the Directive. Some information is provided on required accuracy: capture efficiency of the sampling equipment for particles should exceed certain lower limits, dependent on particle size. A specified reference method for analysis, or any other method demonstrated to be equivalent, is prescribed, together with a minimum required accuracy of 5% of the limit value.

Reporting of concentrations recorded is required within 6 months after the year; on request, the sampling sites and the procedures of sampling and analysis are to be reported.

2.4 Council Directive 85/203/EEC (Nitrogen dioxide)

This Directive defines a limit value and guide values for NO₂. These refer to 50- and 98 percentiles of hourly (or shorter-term averaged) concentrations.

Averaging time is an hour or less, and measurements should be continuous.

Measurements should be carried out in the vicinity of roads with intensive traffic, or in larger areas around major sources; more generally, at places where exceedance are expected, and the risk of human exposure to exceedance is largest.

No quantitative criteria on station spatial density are specified.

A reference method for analysis (or any method demonstrated to be equivalent) is prescribed, and requirements for sampling and calibration procedures are formulated; no quantitative requirements on accuracy are formulated.

Exceedance and concentrations recorded should be reported within 6 months after the year.

2.5 Council Directive 92/72/EEC on air pollution by ozone

This Directive defines five threshold levels for the concentration of ozone as means over one hour, 8 hours and 24 hours. These thresholds are set for the purpose of health protection, vegetation protection, population information, and population warning.

Averaging time of the measurements is an hour, and measurements should be continuous.

The measuring stations should be at representative sites where the risk of approaching or exceeding the thresholds is the highest, and on additional points to allow for description of formation and transport of ozone. No quantitative requirements on network density are provided.

The reference method for analysis specified in the Directive, or a method demonstrated to be equivalent, should be used. Procedures and criteria for sampling, operation and calibration are provided, without requirements on measurement accuracy.

Member States should report the method used to determine the ozone concentrations, the co-ordinates of the measuring stations, a description of the area covered by the stations, the site-selection criteria and the result of any indicative measurement programmes.

Exceedance, periods of exceedance and hourly and eight-hourly concentrations recorded should be reported within 6 months after the year.

Exceedance of the information and warning threshold values, dates and duration of exceedance periods, and the maximum concentrations during such periods should be reported before the end of the following month.

2.6 Council Decision 82/459 (superseding 75/441) on exchange of information on air pollution

This Decision is no longer in force; it expired on 1 October 1989. As it has played an important role in documenting air quality monitoring efforts in Europe and storing data, and as Member States, at the request of the Commission, have agreed to continue to provide data on a voluntary basis, it is shortly summarised here.

The Decision deals with establishing a reciprocal exchange of information and data from networks and individual fixed stations for continuous measurement of air pollution.

In the considerations mentioned in the preamble, it is stated *inter alia* that the transport of pollutants over long distances necessitates surveillance at regional, national, Community and global levels, and that information and data constitute an input to the Global Environmental Monitoring System (GEMS) which is part of the United Nations Environment Programme.

The pollutants considered, to the extent that they are measured at stations in the Member States, and the recommended averaging times are: sulphur dioxide/strong acidity (24h), suspended particulates (24h), particulate heavy metals, e.g. lead, cadmium, etc. (24h), nitrogen oxides (1h), carbon monoxide (1h) and ozone (1h).

Stations to be included are those under the Directives, supplemented by stations reflecting different scales and areas in the Member States. Formats for the exchange of data and of information and measuring procedures are provided. The Commission stored the information received in data bases and made it available to Member States via the so-called APIS information system (see Sluyter et al, 1995; Mol et al, 1995).

2.7 Proposed Council Decision on Exchange of Information on Air Pollution (94/C 281/07) (7 September 1994)

This proposed Decision is an updated and improved version which is to replace the earlier Decision 82/459.

The reciprocal exchange should cover 37 pollutants, insofar as they are measured in the Member States. For 34 pollutants, means, medians, 98 percentiles and maxima are to be reported. For ozone, statistical parameters are also required for 8h-averages. Deposition of three pollutants is to be reported as means. Time resolution is as follows:

1h-average concentrations:

∑ O3, NOx, NO2, CO, PAN
∑ butadiene, formaldehyde

24h- average concentrations:

∑ SO2, Strong Acidity, SPM, PM10, Black Smoke, H2S
∑ Pb, Hg, Cd, Ni, Cr, Mn, As
∑ Benzene, toluene, styrene, acrylonitril
∑ C2HCl3, C2Cl4, CH2Cl2, vinylchloride
∑ B(a)P, PAH
∑ NMVOC, VOC
∑ NH3

monthly average deposition:

∑ acid deposition (wet), N-deposition(wet), S-deposition(wet)

The stations covered under the decisions are those under current air quality Directives, background stations, and, to the extent possible, stations under the earlier EoI Decision.

The Commission is responsible for the implementation of the reciprocal exchange; for matters falling under the competence of the European Environment Agency, the Commission will appeal to this Agency. The data are stored in a data base, and made available to the member states in a personal computer application, developed by EC-DGX1, called APIS (Air Pollution Information System) (see Sluyter et al., 1995; Mol et al, 1995).

Member states are to report new data by October of the subsequent year, by which they also correct and update the information in the data base as made available by the Commission.

Various Annexes of the Directive define in detail the information on measuring networks and stations and measuring techniques, procedures for data validation, calculation of statistics, and quality documentation.

2.8 Proposed Council Directive on Ambient Air Quality Assessment and Management (Framework Directive on Ambient Air Quality)

We refer here to a draft version coded 9514/95, as provided to us on 20-10-1995. **It is to be noted, that the text is currently under development, and subject to change.**

This Directive and subsequent "Daughter Directives", in which limit values are set and criteria for assessment strategies and methods are given for specific pollutants, are to progressively supersede the air quality Directives that are presently in force.

The aspects of this draft Directive most relevant to air quality monitoring are summarised below.

In the preamble, it is stated that:

- ambient air quality needs to be assessed against quality objectives, that are to be set;
- the strategy for this assessment has to be linked to the air pollution levels and to the size of the population and ecosystems exposed to these levels;
- in order to promote the reciprocal exchange of information between Member States and the European Environment Agency (EEA), the Commission with the assistance of the

EEA is to publish a report on ambient air quality in the European Community every three years.

“Ambient air” is defined as outdoor air in the troposphere, excluding the workplace and indoors. “Assessment” is defined in the Directive as any method used to measure, compute, predict or estimate the level of a pollutant in the ambient air.

The pollutants considered are: sulphur dioxide, nitrogen dioxide, fine particulate matter such as soot, suspended particulate matter, lead, ozone (substances covered by EC Directives), and other air pollutants: benzene, polycyclic aromatic hydrocarbons, carbon monoxide, cadmium, arsenic, nickel and mercury.

Averaging times, specific statistics to be considered, and resolution in time and space of measurements are to be defined in the Daughter Directives.

Ambient air quality is to be assessed throughout the territory of the Member States. Measurement is mandatory in agglomerations of more than 250.000 inhabitants with a high population density, and in zones with exceedance of the limit values. The measurements should be taken at fixed sites, continuously or by random sampling, and the number is to be sufficiently large to determine the levels.

For air pollution levels approaching the limit values, combinations of measurements and other assessment techniques (modelling, objective estimation) are allowed. At low concentrations, assessment techniques other than measurements may be used solely.

2.9 Discussion

The ultimate goal of the Directives is protecting human health and environment. For the Framework Directive and the ozone Directive, ecosystems are also included. Information to the public is mentioned as an important goal in several Directives (nitrogen dioxide, ozone, Framework Directive). For these goals to be reached, concentrations above the limit or threshold values, as set, should be avoided, prevented and reduced. The Directives prescribe or describe no methods to assess exposures, risks or effects.

The current and proposed EoI Decisions emphasise that data collection and harmonisation of monitoring information should support the Commission and the Member States in achieving these goals. In fact, the target quantities of the Directives now in force are ambient concentration statistics. Table 1 summarises the monitoring and reporting requirements in the Directives. Note that there is a flexibility in all Directives and Decisions for including new methods and procedures and adjusting the list of compounds in the EoI Decision; Expert Committees are assisting the Commission in this.

Table 1. Schematic overview of concentration monitoring requirements under current CEC Air Quality Directives

Directive	Compound	averaging time	statistics	time resolution	reporting to Comm.
80/779;89/427	SO ₂	1y,24h	mean, 50p.,98p.	24h	6 m aft. y
80/779;89/427	SPM	1y,24h	mean, 50p., 98p.	24h	6 m aft. y
82/884	Lead	1y	annual mean	1-7 d	6 m aft. y
85/203	NO ₂	< 1h	50p., 98p.	<1h	6 m aft. y
92/72	O ₃	1h, 8h, 24h	maximum, 50p., 98p.	1h/8h	1m;*) 6 m aft. y

*) In case of exceedance of information or warning threshold; in these cases, immediate reporting to the public.

Various reports on the assessment and control of the implementation of the Directives have been compiled (CEC, 1995 and references cited therein).

A considerable amount of good work has already been done in the framework of the Directives and the Exchange of Information Decision to stimulate and assure comparability and quality of station siting, methods of sampling and analysis, calculation of quantities, and reporting. On various places, requirements on the accuracy and precision of the measuring and analysis methods are given. More detailed proposals for measuring strategies have been worked out (see e.g. Beier et al, 1985; 1986) but have been implemented to a limited extent only.

Evaluation of experience with these Directives (Zierock,1991) lead to formulation of the new Framework Directive, with some shift from delivering **data** obtained from measurements by prescribed procedures, to delivering **assessments** obtained by various methods by Member States. These assessments should, broadly speaking, include determining areas where limit values or guidelines are exceeded and determining the extent of the exceedance in relation to sources, as air quality management plans should be designed and carried out by Member States to remove these exceedances. So far, no requirements have been formulated in the Directives on the accuracy for determining these areas of exceedance or for the concentration statistics. Determining the areas of exceedance on the basis of measurements alone (as prescribed in the Framework Directive for areas where levels are close to or exceeding limit values) is very difficult and demanding, and requires a well-defined measuring strategy. The necessary density of monitoring stations cannot be determined unless the required accuracy in the area or statistic is specified.

In the draft Framework Directive, "assessment" is defined as "any method used to measure, compute, predict or estimate the level of a pollutant in the ambient air". However, the meaning should also be taken in a broader sense, as: "evaluation, critical analysis, judging nature, significance, status and merit " (Collins English Dictionary, 1991).

In the Fifth Environment Action Programme (CEC, 1993), it is emphasised that environmental policies, next to continuing the essential legislation, should be action-oriented. The policies should stimulate an active interplay between actors (governments, enterprises, the public) and economic sectors (energy, industry, transport, households, tourism). Identifying the actors, sectors and actions to avoid, prevent and reduce the levels

of air pollution, requires assessment of air quality in the broader sense. Quantifying relations of these areas of exceedance to sources and economic sectors requires modelling the air quality, using information on emissions and meteorology. In the current Directives, modelling is not addressed or allowed as an assessment technique; in the Framework Directives modelling is mentioned as a tool for assessment in its more narrow sense only, equivalent to determining the levels.

Developing and implementing assessments in this broader sense, to support the actors, including the Commission, in their shared tasks aiming at solutions of environmental problems, may be considered as one of the major responsibilities of EEA in its tasks to turn data into policy-relevant information.

3. MONITORING REQUIREMENTS FROM INTERNATIONAL CONVENTIONS

3.1 Convention on Long-range Transboundary Air Pollution and its related protocols

A recent review of the 1979 Convention on Long-range Transboundary Air Pollution is provided in ECE (1995). The following protocols to the Convention have been signed: 1985 Sulphur Protocol, 1988 NO_x Protocol, 1991 VOC Protocol and 1994 Sulphur Protocol. The European Community and all Member States are Parties to the Convention and the relevant Protocols with the following exceptions: The NO_x protocol has not been signed by Portugal, the VOC protocol has not been signed by Ireland, the 1994 Sulphur Protocol has not yet been signed by Portugal.

The Convention and the first protocols did not include specific requirements for monitoring. They do, however, include general references to monitoring. An example is Article 9 of the Convention, where the Contracting Parties agree to emphasise “the desirability of Contracting Parties joining in and fully implementing EMEP”. According to Article 6 of the NO_x protocol, the Parties “shall give high priority to research and monitoring related to the development and application of an approach based on critical loads ...”. Article 9 of the VOC Protocol indirectly contains a commitment to ozone monitoring: “EMEP shall, using appropriate models and measurements, provide to the annual meetings of the Executive Body relevant information on the long-range transport of ozone in Europe”.

The strongest commitment concerning monitoring is given in the 1994 Sulphur Protocol. Article 4, paragraph 2 states that “Each Party shall collect and maintain information on: (a) Actual levels of sulphur emissions, and of ambient concentrations and depositions of oxidised sulphur and other acidifying compounds, taking into account, ..., the work plan of EMEP.” Furthermore, in Article 5, paragraph 3: “..., EMEP shall provide information on: (a) Ambient concentrations and deposition of oxidised sulphur compounds,” . A full implementation of the EMEP measurement programme would also support regular reviews of the compliance of Parties with their obligations, as set out in Article 9 of the 1994 Sulphur Protocol.

The quotations above imply that the EU Member States should take part in EMEP’s measurement programme. This presently includes the following components:

Precipitation: pH/H⁺, SO₄⁻, NO₃⁻, NH₄⁺, Ca²⁺, K⁺, Cl⁻, Na⁺, Mg²⁺, conductivity;

Aerosols: SO₄⁻, NO₃⁻, NH₄⁺;

Gases: SO₂, NO₂, HNO₃, NH₃, O₃.

Measurements are taken on a 24-hour basis, except for ozone where hourly averages are required. An extension of EMEP to include heavy metals and persistent organic compounds is under consideration.

A recent overview of monitoring efforts in EMEP Framework is provided in EMEP/CCC Note 5/95 (EMEP, 1995). The CEC and all EU Member States, and all EEA member states, with the exception of Iceland, are party to EMEP (status as of March 1994), although the measurement programmes are often incomplete

The implementation of EMEP is presently being reviewed. As a first step, the Steering Body to EMEP in 1994 reviewed the distribution of monitoring sites and implementation of the measurement programme. EMEP measurements are intended to provide information on concentrations and depositions in rural areas in Europe with a spatial resolution of about 200 km. However, to achieve this, additional stations have to be established. For EU Member States, the review recommended that additional sites should be established and/or additional measurements undertaken in the following EU Member States: Austria, Belgium, France, Greece, Italy, Portugal and Spain (EB.AIR/GE.1/R.90). Required accuracy of EMEP measurements has not yet been agreed upon. It is likely that the required accuracy of the chemical analyses will be 5-10%. In addition, the representativity of a site will have to be evaluated. It is likely that this will be the major uncertainty of the measurement data.

Summary reports showing e.g. the measured and/or modelled geographical distribution over Europe of ozone and of sulphur and nitrogen compounds in air and precipitation are published annually; see for instance Barrett et al. (1995); Hjelbrekke et. al, (1995)

3.2 Regional Marine Conventions

The relevant agreements are:

- the Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR Convention, replacing the Oslo Convention and the Paris Convention),
- the Convention on the Protection of the Marine Environment of the Baltic Sea Area (Helsinki Convention, HELCOM),
- the Convention for the Protection of the Mediterranean Sea against Pollution (Barcelona Convention, under the UNEP Regional Seas Programme).

EU Member States have signed and/or ratified these Conventions as follows:

- | | |
|------------|---|
| OSPAR: | Belgium, Denmark, Finland, France, Germany, Ireland, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom. |
| HELCOM: | Denmark, Finland, Germany and Sweden. |
| Barcelona: | France, Greece, Italy and Spain. |

The European Commission is party to PARCOM, and intends to join OSPARCOM.

The monitoring activities under these conventions are mainly focused on the marine environment. However, since atmospheric input to the sea may play a significant role, atmospheric deposition monitoring programmes have been established also for the regional marine conventions.

The regional seas monitoring programmes are not fully harmonised but are generally focused on measurements of nutrients (N-compounds), heavy metals and persistent organic pollutants, and some also include ozone. The heavy metals with highest priority are Pb, Cd and Zn and organic species included in one or more of the programmes are PCBs, DDTs, HCHs, HCBs, PAHs and dioxins. Within the Comprehensive Atmospheric Monitoring Programme (CAMP) of the Paris Commission, measurements of ammonium, nitrate, cadmium, mercury, arsenic, chromium, copper, lead and zinc, alpha-HCH and gamma-HCH in precipitation are compulsory. Air concentration measurements, primarily of nitrogen components, are carried out on a voluntary basis. The Helsinki Commission has recommended that the countries should undertake atmospheric deposition measurements. The list of components is similar to that of CAMP. The regional seas monitoring programmes are mainly based on monthly deposition values. Most of the stations are located on the coast, and a major problem is therefore the lack of stations located at sea. The spatial resolution has not been specified.

3.3 Global conventions

The relevant conventions are the United Nations Framework Convention on Climate Change (FCCC), and the Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol, amended in London and Copenhagen, on Substances that Deplete the Ozone Layer.

The FCCC does not contain any specific monitoring requirements. There is a general reference to monitoring needs in Article 4, paragraph 1 (g), where the parties commit themselves to “promote and co-operate in systematic observation and development of data archives related to the climate system”. The needs for international co-operation in this area is laid down in Article 5 on research and systematic observations.

Neither the Vienna Convention nor the Montreal Protocol contain legal commitments concerning air quality monitoring.

Thus, the global conventions related to air pollution do not contain strict legally binding commitments to air quality monitoring. Developed countries have, however, a “moral” obligation to contribute actively through international co-operation to a better understanding of global atmospheric problems. Of particular importance in this context is the Global Atmosphere Watch (GAW) organised under the World Meteorological Organisation to integrate monitoring and research activities involving measurement of atmospheric composition. The GAW serves as a system to detect further changes in atmospheric concentrations of greenhouse gases, changes in the ozone layer and in the long-range transport of pollutants.

A recent overview of the status of GAW is provided in WMO-report no.99 (WMO, 1995). Measurements under GAW are currently made at regional stations, addressing regional aspects of the pollution, and global stations, providing information on global scale; these are located at remote locations, where no major changes in land use are to be expected.

The components measured include:

- Chemical composition of rainfall and snow
- Atmospheric gases, including:
 - greenhouse gases: CO₂, CFC, their substitutes and degradation products, CH₄, N₂O, tropospheric ozone, water vapour
 - ozone, surface, total column, vertical profile and precursor gases
 - reactive gas species: SO₂, reduced S-species, NO_x, CO
- aerosols and optical depth or transparency of the atmosphere including:
 - total concentration and physical and chemical characteristics of particles, and their vertical profiles
 - turbidity, optical depth, visibility
- solar radiation including UV-B
- radionuclides

More detailed information on the requirement for these compounds can be found in WMO report no.86 (WMO, 1993); for a recent status report, see WMO (1995).

Quality assurance protocols and manuals are in preparation or under development for these measurements. Reporting is to five global data centres, from which reports - in some cases on CD-ROM - are available.

4. MONITORING INFORMATION AS REQUIRED FOR EUROPEAN ASSESSMENT REPORTS

4.1. Introduction

An important function of monitoring is to provide information for assessments. In this chapter, the air quality information needs for such assessments are reviewed. The following assessment reports and draft reports and definition documents have been considered:

- Europe's Environment, the Dobriř assessment (EEA, 1995a)
- The State of Environment in the European Community (CEC, 1992).
- Concern for Europe's Tomorrow (WHO-ECEH, 1995)
- The State of the Environment (OECD, 1991).

In addition, the monitoring requirements in the CEC Fifth Action Programme "Towards Sustainability" (CEC, 1993) and in the Working Programmes of EEA (EEA, 1994 a, b) have been considered.

In this review, problems with radioactive substances in air, indoor air problems and pollution in the working place have not been covered.

4.2 Review

4.2.1 Europe's Environment, the Dobriř assessment

This is the most complete and recent assessment report on the environment in Europe. The report, that covers the whole of geographical Europe, is structured in six parts:

1. The context, on the reports context and on reporting techniques.
2. The assessment, on the state of environment in eight different fields.
3. The pressures, on pressures which impact on the environment.
4. Human Activity, on human activities, as sources of these pressures.
5. Problems, on twelve major environmental problems in Europe.
6. Conclusions.

There are numerous text fragments and references in the report relating to air pollution and air quality. It is evident from the report that air quality in many cases is only one intermediate step in the complex chain starting from human activities and emissions and leading to exposure and to a variety of impacts and effects. However, the chapters most directly relevant to air quality are:

- chapter 4 entitled "Air" in part 2, where an assessment for air is given;

a number of chapters in part 5, viz.:

- chapter 27, "Climate change"

- chapter 28, “Stratospheric ozone depletion”
- chapter 31, “Acidification”
- chapter 32, “Tropospheric ozone and other photochemical oxidants”
- chapter 37, “Urban stress”

More indirectly relating to air quality are:

- chapter 10, “The urban environment” in part 2
- chapter 11, “Human health” in part 2
- chapter 14, “Emissions”, particularly atmospheric emissions

Most of the monitoring information that has been used in chapter 4, “Air” has been likewise the basis for the assessments in the other chapters. Therefore, our analysis follows the line of analysis of this chapter, with reference to the other chapters wherever necessary.

Urban and local air pollution

The results for **urban air pollution and population exposure** in selected European cities (cities with more than 500.000 inhabitants) rely on monitoring information as obtained from the city monitoring authorities by questionnaire (RIVM/NILU, 1995 a, b). Part of the information for the EU countries was also obtained from the data system APIS established by the CEC from the data provided in the framework of Council Decision 82/459 (Exchange of Information), and the WHO/UNEP GEMS-AIR system. The requested information on air quality was not available or incomplete for many cities, and information on data quality was often lacking.

The compounds or compound groups on which monitoring information was collected were:

- winter type smog, as represented by concentrations of SO₂ and particulate matter, measured by black smoke or filter/gravimetric methods, including PM₁₀; (24-hour averages, annual averages);
- summer type smog, characterised by concentrations of O₃ (1-h average);
- concentrations of NO₂ (24-h average);
- concentrations of CO (8-h average);
- concentrations of Pb (annual average);
- concentrations of toxic volatile organic compounds, such as benzene and benzo(a)pyrene (annual average).

Data were requested for city background monitoring stations, i.e. located within the built-up area, but away from busy streets and industrial sources. In addition, data were requested for a traffic and industrial station measuring the highest concentration.

The data could be used to estimate exceedance of WHO Air Quality Guidelines (AQG) for SO₂+SPM, O₃ and NO₂ (short term), for SO₂+Black Smoke and lead (long term). Exposure of the population in ambient air to exceedance of the WHO-AQG could be estimated for the winter smog pollutants SO₂+SPM. It has to be emphasised that data availability was strongly limiting the quality and completeness of the urban air quality assessment.

The most important pollutants for **assessing damage to materials, buildings and cultural heritage** are SO₂ (annual average concentrations), NO₂ and O₃.

Data on air pollutants relevant for **local exposure to toxic air pollution from industry** was again obtained from the response on a simple questionnaire (RIVM/NILU, 1995 a, b).

Systematic collection of monitoring data on air pollutants in Europe had not been available before, except for selected data from the then 12 EU countries. The data were incomplete and often not very detailed. From the data reported, those on SO₂ (particularly 1-hour average concentrations), and concentrations of particulate matter close to industrial installations are probably most relevant for population exposure. Other compounds mentioned in this rather incomplete assessment study are heavy metals, fluoride, ammonia, lead, hydrogen chloride, and polycyclic aromatic hydrocarbons (PAH). Various other toxic components may have contributed to population exposure.

It is concluded in the report, that “in many cities, consistent information on... air concentrations ... is not available. Pollution peaks in urban/industrial areas can occur unnoticed by existing monitoring networks due to the scarcity of the network, unsampled pollutants, inappropriate locations, and obsolete or ill-maintained apparatus. Monitoring systems need improvement. To obtain a consistent and regular assessment of air quality in Europe there is a need to monitor, collect, and evaluate data on urban air pollution, human exposure and health effects in a harmonised manner at the European scale”

In the chapter on **urban stress**, these recommendations are put on a broader basis. It is stated:

“The collection of consistent information on urban environment quality and the pressure of urban activities on the regional and global environment is required to establish clear relationships between changes in the state of the urban environment and patterns of urban development. The environmental performance of urban area needs to be monitored through a consistent set of environmental indicators to provide guidance in formulating and implementing urban environmental policies.”

Regional and transboundary air pollution

The results in this section for **acid deposition** rely on total (wet + dry) atmospheric deposition estimates on a 150x 150 km scale derived from modelling studies in the EMEP-framework. However, these models have been evaluated by comparison with measurements from the EMEP-network. These measurements (see chapter 3) include concentrations (24 hour averages) in air of acid or acidifying substances (SO₂, sulphate aerosol, NO, NO₂, HNO₃, nitrate aerosol, NH₃, ammonium aerosol), and the concentrations of sulphate, nitrate and ammonium and a number of other ions in precipitation (daily or weekly averages). The EMEP network is a large scale background air pollution network. The relevant quantity needed for the assessment is annual average atmospheric deposition, as this is to be compared to critical loads of sulphur, acidity or nitrogen, to determine exceedance. Total deposition, in particular dry deposition, has so far not been monitored in Europe or derived from monitored concentrations, in combination with meteorological observations and dry deposition velocities from experimental studies; however, several pilot projects have demonstrated the feasibility of these approaches (Erisman and Draaijers, 1995). Work is ongoing to generate deposition estimates on smaller scales (50 x 50 km or less) (Sandnes, 1995).

For **summer smog**, hourly concentrations of ozone as measured in the EMEP and EUROTRAC-TOR networks have been used as the monitoring basis for the assessment. As, however, the coverage of these networks is incomplete or even largely lacking in Southern, Central and Eastern Europe, the assessment relies on model calculations with the

EMEP-model. This model has been evaluated against measurements in the aforementioned networks (Simpson, 1993) The measurements of VOC and NO_x, and various other photochemical products, such as aldehydes, PAN, nitric acid, organic nitrates and H₂O₂ in the EMEP- and TOR measuring networks are also necessary for evaluation and validation of these models.

For **winter smog**, the most important pollutants are SO₂ and suspended particulate matter. The relevant quantities are hourly or 24 h averaged concentrations. Other pollutants related to winter smog are CO, NO₂, and a wide range of aerosol-bound pollutants. The report shows as an example a winter smog episode in Northern Bohemia, illustrating the need for national or regional network data. In the EU, these data are available in the APIS database. The evident requirement on smog warning networks to produce data in near real time is not essential for assessment reports.

Assessments of **aerosol particles** concentration fields over Europe formed a major problem in this report. Few stations report their data in international data collecting programmes, many data were representative for urban and local scales rather than for continental scale, and the variety of measuring techniques made intercomparability of the data quite limited. The report used a model calculation to estimate an annual averaged concentration field, that is not inconsistent with available measurements. For sulphate, ammonium and nitrate in aerosol, EMEP measurements are available in Europe; for suspended particulate matter, black smoke or other aerosol measurements, no European database exist except for the 12 EU countries (APIS).

Visibility reduction is related to air pollution, particularly sulphate and nitrate aerosol, for which measurements are available from the EMEP network and from national networks.

For **heavy metals and persistent organic pollutants**, as in earlier cases, model calculations have been used to generate maps of the most relevant quantity, the annual average deposition (Galperin et al., 1995). These calculations have been evaluated by comparison to the generally few measurements (van Jaarsveld, 1994) from various networks measuring daily or weekly averages of air concentrations, and monthly averages of concentration in precipitation. An exception is lead, for which relatively much measurements exist.

For the continental scale, it is concluded in the report that:

- monitoring coverage is still insufficient for ozone and VOC, and especially for compounds such as toxic aerosol components, metals and persistent organic pollutants;
- the EMEP network for assessing acid deposition is still too coarse in south-western and eastern Europe;
- dry deposition is still estimated indirectly by non-harmonised methods;
- a framework for assessment of suspended particulate matter is lacking.

Global air pollution

The assessments for **tropospheric change** are derived from current European and global measurement networks, particularly the EUROTRAC-TOR and EMEP networks, and the WMO Global Atmospheric Watch (GAW), including or supplemented by the ALE/GAGE/AGAGE and NOAA-CMDL networks. These networks determine

concentrations of ozone and other greenhouse gases (CO₂, CH₄, N₂O, CFCs and related compounds) in long-term trend measurements of averages over the order of one hour. For ozone, also vertical profile measurements are available. These recent measurements have been used in combination with historic measurements to draw conclusions on long-term trends in ground-level and Tropospheric ozone and other greenhouse gases.

The assessment on **depletion of stratospheric ozone** relies on monitoring efforts under the WMO GAW, particularly the Global Ozone Observing System (GO3OS), and the Network for Detection of Stratospheric Change (NDSC), providing mainly ground based measurements of total ozone column and ozone profiles, and concentrations of related compounds. Satellite-born observations of stratospheric composition are playing a role of ever-increasing importance, allowing an overview of the concentration fields with global coverage. Information on recent developments as reported in the "Europe's Environment" report also derives from large measuring campaigns set up by European scientists (EASOE). A related quantity is UV-B radiation, for which the quality of the measurements at the time of the assessments did not allow for detection of a trend. Since then, rapid improvements are being made.

The most relevant air quality monitoring data for **climate change** are the measurements of greenhouse gases already mentioned under tropospheric change. Needless to say that the broad issues of climate change rely on many more monitoring efforts, such as meteorological, oceanographic, biospheric, cryospheric, geological and land cover monitoring. No specific monitoring recommendations for global air pollution are made in the report.

4.2.2 The State of Environment in the European Community (CEC, 1992)

This is an earlier, and much more general overview of the state of environment, and it relates only to the European Community.

The report covers three parts: the state of the environment, the causes of environmental deterioration, and the economical aspects. In the chapter on air in the first part, air quality, sources of air pollution, stratospheric ozone depletion and climate change are addressed. In the chapter on soil, acidification by atmospheric deposition and accumulation of heavy metals and organochlorines are referred to.

The assessments on air quality in this report are based on information provided by member states under Decisions 75/441/EEC and 82/459/EEC (Exchange of Information), and under the air quality Directives for SO₂ and suspended particulates, for NO₂ and for Lead. It is stated that this information is not sufficient to draw meaningful conclusions on the development of air quality.

For stratospheric ozone depletion and climate change, no reference is made to measured data.

For acidification, a preliminary estimate has been made on exceedance of critical loads on the basis of EMEP data on deposition.

During the preparation of the present report, EEA published in November 1995 "Environment in the European Union, Report for the Review of the Fifth Environmental

Action Programme" (EEA, 1995b). Time constraints precluded a discussion of this report here.

4.2.3 Concern for Europe's Tomorrow (WHO); the WHO/UNEP GEMS/AIR programme.

Concern for Europe's tomorrow

The Study "Concern for Europe's Tomorrow" (WHO-ECEH, 1995) was published in the second half of 1995. In drafting the present report, we referred here to "Concern for Europe's Tomorrow- Summary " (WHO, 1994) and to a draft of the main report, kindly provided by WHO-ECEH.

The main aim of this study was to provide a balanced and objective overview of the principal environmental issues of present or potential concern for health in the WHO European region. While the report does not provide a detailed comparative risk assessment, it is meant to help achieve a better understanding of the more important environmental factors that affect the health of the overall population or of potentially vulnerable groups.

The report contains three major parts:

I. Background.

In this part, economic sectors, environmental health management, environment-health-economic interrelations, and the state of human health are addressed.

II. Environmental Exposure.

In this part the exposure resulting from environmental problems in various environments are addressed.

III. Analysis, discussion, conclusions and recommendations.

Important information in this part is the estimated health effects of environmental exposure from various media, and the impacts of economic activities on environmental health.

The chapter most relevant to this review is chapter 5, Air pollution, in Part II, which also contains chapters on aspects of air pollution in the indoor environment and in occupational health, but these fields are outside the scope of this review.

In the estimates of exposure to ambient air pollution, two different approaches were used. For rural areas, ambient air concentration was calculated with long range transport models. For urban areas, actual measurement data were used as the basis for analysis.

In rural areas, daily averaged concentrations for SO₂, NO₂ and O₃ were calculated with the EMEP-model, and for lead with the TRACE model.

For the urban population exposure, ambient concentration data were analysed from the following sources:

- the Exchange of Information database of the CEC;
- the data base of the UN-ECE International Co-operative Programme on effects on Materials;
- data returned directly from countries in response to WHO protocols;
- Helsinki Metropolitan area air quality data;
- "The Environment in Europe and North America" Annotated Statistics 1992 , UN-ECE;

- for ozone, calculations with the EMEP-model.

Full references are provided in the draft CET report.

Daily and annual average concentrations have been collected for SO₂, TSP (total suspended particulates), Black Smoke, NO₂ and Lead. Based on daily or hourly data available for some cities, empirical regression models have been applied to describe the relation between annual average values and exceedance of the daily WHO Air Quality Guidelines.

Particularly relevant to our review is the following recommendation formulated in the CET Summary:

Strategies should be adopted for comprehensive environmental health monitoring with clearly defined objectives, taking into account all routes of exposure. They should be adapted to local needs but, for data to be comparable and to facilitate regional analysis, a harmonised approach must be taken to sampling, analytical and statistical procedures, quality assurance and reporting.

The GEMS/AIR programme

GEMS/AIR is an urban air pollution monitoring and assessment programme, that started from a WHO pilot project in 1973, and was operated from 1975 by WHO and UNEP as a component of the UN Global Environment Monitoring System (GEMS). (UNEP/WHO, 1993) Its original objectives are:

- to strengthen urban air pollution monitoring capabilities in participating countries;
- to improve the validity and comparability of data amongst cities;
- to provide global assessments on levels and trends of urban air pollutants, and their effect on human and ecosystem health.

Since then, the programme has evolved considerably, while the central goal of the programme moves in its emphasis to providing and exchanging the comprehensive information needed for air quality management, rather than supporting air quality monitoring and assessment only.

While originally the programme concentrated on SO₂ and SPM, the phase 2 programme started in 1993 includes also data on all common air pollutants, such as CO, NO, NO₂, O₃, and Pb. The GEMS/AIR network has included some 270 monitoring sites in 86 cities in 45 countries (situation in 1993). The database of GEMS/AIR, called AIRS, is hosted by US-EPA.

4.2.4 The State of the Environment (OECD)

The third OECD Report on the State of the Environment (OECD, 1991) aims at

- assisting Member Countries in the definition, implementation and evaluation of environmental policies;
- helping them to incorporate environmental concerns into economic decision-making in order to progress towards sustainable development;
- providing environmental information to the public.

The report contains three major parts:

- I. The State of the environment: progress and concerns.
- II. A changing economic context.
- III. Managing the environment: towards sustainability.

The report ends with conclusions on the state of the environment.

The chapters most relevant to this review are in part I:

- Global atmospheric issues;
this chapter deals with stratospheric ozone depletion, the greenhouse effect, and other global atmospheric pollution;
- Air;
this chapter covers local and urban air pollution covering traditional air pollutants and toxic trace pollutants, and large-scale air pollution, including acid deposition, photochemical smog, and deposition of heavy metals.

Next to this, there are numerous cross-references in other chapters, such as those on the marine environment, on soil, on forests, and on wild life, and those on the economic sectors in part II.

The report draws on the OECD environmental database, as well as other evidence and scientific expertise accumulated by OECD. It also builds on information from national reports on the state of the environment and from national environmental yearbooks. As references to sources other than OECD are rare in the report, it is difficult to track the monitoring data on which the report relies.

For **stratospheric ozone depletion**, the report refers mainly to the 1989 NASA/NOAA/WMO/UNEP assessment of ozone data, including data from ground stations and satellites on total ozone column and ozone vertical concentration profiles. For the **greenhouse gases** carbon dioxide, methane, dinitrogen oxide, ozone and chlorofluorocarbons, concentration data shown are not fully referenced, but reference is made to the 1990 IPCC report. As a third global issue, **aerosols** are considered, referring to satellite data and polar studies.

In the section on **local and urban air pollution**, the traditional air pollutants include sulphur and nitrogen oxides, carbon monoxide, ozone, lead and particulate matter. Information on concentration levels (annual averages, daily and hourly means) of these pollutants is provided from OECD-data and non-referenced sources. Next to these traditional pollutants, toxic trace pollutants are considered, grouped into four major categories:

- heavy metals;
- organic compounds;
- radioactive particles and gases;
- fibres (such as asbestos).

For these there is some information on emissions and effects, but hardly any information on ambient concentrations. A major part of the toxic pollutant problems are most relevant indoors and at the work place.

The section on large-scale air pollution is not explicitly referring to monitoring data or monitoring requirements for **acid deposition, photochemical smog pollution, or deposition of heavy metals**.

In the final concluding sections of the report, there is an interesting box entitled "Conclusions on environmental information". In this box, it is stated that:

“environmental information in the 1990s will have to adapt to a new context which shapes the demand for environmental information:

- changing environmental policy priorities, reflecting, above all, the international, intersectoral and economic dimensions of sustainable development;
- increasing demands for reliable, harmonised and comparable environmental information from governments, business and the public;
- progress with regard to scientific knowledge and to measurement and information technology.”

In this context, it is stated: “Monitoring systems, although often very useful for research purposes, too often lead to situations of being “data rich and information poor”. They need to be reassessed and made more responsive to new policy priorities”. According to the report, this will require correcting gaps, unbalances and weaknesses, promoting more integrated approaches, improving the quality and comparability of the results, disseminating and making better use of monitoring results for decision-making, better co-ordination of monitoring carried on by various bodies, agencies, firms, and institutes, and making monitoring efforts more cost-effective and financing them with a proper mix of public and private funds.

4.2.5 The EC Fifth Environmental Action Programme: “Towards Sustainability”

This document (EC, 1993) describes “a European Community programme of policy and action in relation to environment and sustainable development”. The emphasis in this document is on action, actors and on economic sectors that are causing environmental problems rather than on environmental compartments; consequently, there is only limited reference to air quality monitoring. The document discusses some themes related to air pollution:

- for **climate change**, no monitoring requirements are specified. For CH₄, an inventory of data is requested, without further specification.(section 5.1 of the document);
- for **acidification**, no monitoring requirements for acid deposition are specified. As an illustration, the report shows maps of exceedance of critical loads as calculated by the IIASA RAINS model, that relies on deposition as modelled in the UN-ECE-EMEP framework (section 5.2);
- for **air quality**, used here in a more narrow sense, the document (section 5.2) specifies as one of the “measures needed to guarantee levels of air quality which are not detrimental to health and environment”, “air quality monitoring and control of concentration levels with regard to norms on all substances covered by legislation”.

This includes existing legislation on SO₂, NO₂, Lead, Particulates and Black smoke, as well as targets specified in a Directive for O₃ (see chapter 2 of the present report), and WHO Air Quality Guidelines, which are to become mandatory before 2000 at EC level. Knowledge of existing levels is required for CO, Cd, other heavy metals, organic compounds and deposition of sulphur and nitrogen.

More generally, the document is urging for improvement of environmental data, highlighting in chapter 7 lacunae and deficiencies in environmental information. Next to “a serious lack of baseline data” this chapter emphasises that “the available information is

often not processed or presented in a suitable form for potential end-users - administrations, enterprises and the general public - and does not take into account of the different levels of sophistication or simplification required....". It is further stated that a substantially increased R&D effort is required that should provide direct support to inter alia advanced monitoring and assessment systems (section 7.2 of the document). Improvement of environmental data is given priority (chapter 14 of the document).

In chapter 11 on international co-operation, the document summarises the commitment and the active role of the European Community in various international agreements, without, however, specifying an explicit monitoring effort. In a table on international environmental issues, the document lists under "measures required" inventories of greenhouse gases reservoirs and sinks and a review of scientific data and response for protection of the ozone layer, again without clarifying what monitoring or assessment information is needed.

Recently, in November 1995, EEA published the report "Environment of the European Union 1995, report for the review of the Fifth Environmental Action Programme" (EEA, 1995b). Results of this report could not be included in the present report.

4.2.6. The EEA Working Programmes

In the EEA Multi-annual Work Programme 1994-1999 (EEA, 1994a), 10 programmes are documented.

Although all of these have some relationship with air quality information, air quality is more directly involved in the following programmes:

2. Periodical Reports on the State of the Environment
4. Media-oriented Monitoring, assessment of the state and trends of the environment
5. Source-oriented monitoring, assessment of pressures
6. Integrated environmental assessment- problems, areas and sectors
7. Scenario's for environmental improvement

The **Periodical Reports Programme** consists of five projects:

PR1 Publication of *Europe's Environment*

PR2 Development of products of *Europe's Environment*

PR3 Development of monographs on *Europe's Environment*

PR4 Triennial report on the state of the environment

PR5 Reports in agreement with other institutions

An objective of project PR3 is to initiate a monograph series on the basis of the Europe's Environment Report, and to ensure dissemination of more in-depth analyses of chosen fields.

Among these, Urban Air is planned to be covered in 1995. Other fields for 1995 with some relation to air pollution are the Arctic/Polar Environment and the Urban Environment.

In project PR4, the objective is to publish regularly every 3 years a State of Environment report. Planning of the work and preparatory activities are planned for 1995; First drafts are to be collated after 1995.

In project PR5, one of the objectives is to draft reports as demanded by European Commission, European Parliament and for international conventions.

In the fifth Environmental Action Programme, the European Commission states that “a comprehensive reappraisal of the situation will be undertaken and an up-to-date report on the state of the environment and a review of the policy-cum-strategy set out in this Programme will be published before the end of 1995” The European Commission has asked the European Environment Agency to produce the above-mentioned state of environment report, requesting that beside producing an update, the EEA should also carry out an evaluation of the progress and prospects of the fifth EAP. The report of this activity has been published in November 1995 (EEA, 1995b)

In the **Media-oriented Monitoring Programme**, the most relevant projects are:

- MA1 Air Quality, general approach to assessment

The objective of this project is to establish a first evaluation and a general approach of air quality monitoring and assessment. The present report is part of this project. (see also section 1., Introduction)

- MA2 European air quality monitoring networks and databases - establishment and maintenance

The objective of this project is to set up and ensure operation of the network and exploitation of data base.

- MA3 Harmonisation in the use of models for ambient air quality and pollution dispersion and transport. The goal of this project is to increase consistency in model use, and to develop guidance in selection and application of models for assessment and management of air quality.

More information on these projects, that are currently being carried out by the European Topic Centre on Air Quality is to be found in its work plan (European Topic Centre on Air Quality, 1995)

In the **Source-oriented Monitoring** programme, two projects are most relevant to air quality:

- SA1 Air emissions - general approach and assessment

The objective of this project is analysis of the situation and development of guidelines for air emission inventories at different levels and Europe-wide.

This project is currently carried out by the European Topic Centre on Air Emissions; see for results (European Topic Centre on Air Emissions, 1995a)

- SA2 Air emission inventories 1990 and 1994

The objective of this project is to compile, validate and diffuse inventories for 1990 and 1994, and to contribute to EMEP and other fora.

This project is currently carried out by the European Topic Centre on Air Emissions; see for results (European Topic Centre on Air Emissions, 1995b). The Topic Centre has reported on the CORINAIR 90 emission inventory, with air emissions for 28 European countries and detailed in sub-areas (in various levels off detail), and attributed to economic sectors, for the following pollutants: SO₂, NO_x, CO₂, CH₄, N₂O, NMVOC, CO, and NH₃. The Topic Centre has provided planning schedules for reporting on 1994 emissions

in stages, resulting in complete reporting early 1997. Moreover, the Topic Centre is planning to review urban emission inventory methodology, and provide guidance for a harmonised approach for inventories at this level.

In the **Integrated Environmental Assessment** programme, the following projects are most related to air quality:

- IAP1 Identification of need and feasibility of integrated analysis for specific problems.
The goal of this project is to gather and analyse information on relevant problems (among which acidification is mentioned) and develop a programme for assessment of priority problems.

- IAP4 Threats to human health
Goal is to develop together with WHO-ECEH and other relevant institutes and programmes a comprehensive view on this, and necessary databases.
There is no doubt that air quality information will be an important part of this.

-IAR1 Integrated assessment of urban areas
Goals are to compile and evaluate information on situation and trends in the urban environment, and development of a systematic approach to assessment of the information, and identification and evaluation of measures.
Again, there is no doubt that air quality information will be an important part of this.

In the **Scenario's for Environmental Improvement**, there is one project explicitly related to air pollution:

- SC2 Analysis of cases - Air emission reduction scenario
Goal of this project is to evaluate effects of environmental and other measures in terms of reduction of emissions to air.

4.3 Discussion and conclusions

In many of the assessments of air quality or related issues as reviewed here, it is concluded or evident that monitoring information as needed is often not available, incomplete in coverage, not up-to date, incomparable, and of insufficient quality. Although from several countries, much monitoring data and information of good quality is available, the main challenge in assessing the air pollution situation in Europe is still the availability of recent, harmonised information, particularly for urban areas and “hot spots”, and for quantities such as concentrations of particulates, ozone, volatile and persistent or toxic organic compounds, and heavy metals, but also for dry deposition of sulphur and nitrogen species on regional scales.

Lack of documentation and harmonisation in methods of sampling and analysis, in station siting, and in assessment techniques makes it particularly difficult to compare data and information from different areas in Europe. For continental and global scale problems, the situation is better than for urban/local problems, as well-established international frameworks for assessment such as EMEP, WMO/UNEP and IPCC have stimulated harmonisation and improved quality documentation. The authority of these assessments and the explicit use by policy makers is an important aspect here; in this respect, the European Union has made a major step forward by the production of the Europe’s Environment report, and by establishing the EEA, with a major responsibility for future assessments.

A striking feature is that requirements on quality, accuracy and coverage in space and time of the information needed for the assessments have hardly been formulated; these requirements, however, are of paramount importance for requirements on network density, station representativity, and measuring accuracy.

As a consequence of the lack of comparable and readily available monitoring information, much of the information used in European assessment studies is really obtained from modelling studies, supported by monitoring data for validation; or from generalisation of monitoring information by modelling. This requires adequate information on air emissions and on meteorology to be available. Without such information, it is hard to quantify to what extent high concentrations or exceedance of guidelines or standards are caused by (exceptional) meteorological situations, or by excessive emissions.

More fundamentally, as assessments require the relation with sources and human activities to be made, information on emissions of air pollutants is essential to air quality assessments. In view of this interconnection the information collection strategy for air quality monitoring and for air emissions should be closely co-ordinated. EEA could have an important role in this.

Air quality monitoring information is also needed for environmental assessments other than on air quality. For instance, atmospheric deposition is an important input route for acidifying compounds, nutrients and substances toxic to ecosystems of soils, forests, freshwater, ground water and marine waters. Information on exposure as needed for assessment of environmental health effects and of effects on ecosystems is another important example. This means that requirements for air quality monitoring information should also be developed and formulated from those perspectives.

5. MONITORING REQUIREMENTS OF EUROPEAN STATES

5.1 Information collection

Information has been collected on monitoring requirements of European states by means of a questionnaire (Annex 1). For clarification, a short informative note on goals and functions of monitoring and a list of international frameworks actually or potentially relevant to monitoring was included. The questionnaire was sent by 17 February 1995 to the (then) 17 EEA member countries, and to a further 21 European countries on February 28 (Annex 2). Involving these other states was considered as a useful extension, in view of the pan-European character of the Dobriš report and other assessment studies such as EMEP, and the concurrent pan-European efforts in the compilation of air emissions by the European Topic Centre on Air Emissions, and EMEP. Response was requested by 10 March for EEA member states, and by 24 March for the other states. By 27 March, responses were obtained from 4 out of 17 EEA member states; and 2 out of 21 non-member states. In the course of the year, more responses were received. Table 1 provides an overview of the responses received by November 1995. As is apparent from this Table, 14 or 82 % of the 17 EEA member states responded; from the 21 non-EEA European states, 6 or 29 % responded. In addition to these returned questionnaire, there were reactions from Bulgaria and Malta.

Mr. Micallef (Malta) reported that currently there are no legal requirements on air quality monitoring, and that the Clean Air Act of Malta is due for updating. Malta is not as yet party to the Convention on LRTAP, but it is to the Vienna Convention and its Montreal Protocol, to the Climate Change Convention, and to the Barcelona Convention.

Mr. Kandev (Bulgaria) drew attention to the Third Ministerial Conference in Sofia, 1995. He welcomed a report on the state of air quality in Europe. Bulgaria has now 105 air quality monitoring stations, including 14 automatic stations, and continues to build this network up with PHARE support.

It has to be noted that the material presented in this chapter has been compiled from the information in the responses to the questionnaire. The EEA countries have been asked to check the information as contained in a draft version of this report, and their comments have been taken into account. Nevertheless, due to distributed responsibilities for monitoring in various countries or to incomplete responses, it is possible that the information is incomplete or incorrect.

Table 1. Overview of responses to the questionnaire.

state	respondent	applications ¹	documents
Austria	Spangl	rn, ai, pi, ia, sr	1
Belgium	Derouane	ri, rn*, an*, pi, sr	2
Cyprus	Kleanthous	rn, cn, ai, an, pi	
Czech Republic	Santroch	ri, rn, pi	
Denmark	Heidam Palmgren	ri, rn, ai, an, ia, ri, rn, pi, sr	4
Germany	Schlegelmich, Kallweit, Uhse	ri, rn, ai, an, ia, rn, pi, sr	23
Greece	Viras	ri, ci, cn, an, pi	
Finland	Joffre Pohjola	ai, pi, sr cn	1 1
Hungary	Toth	rn, pi, ia	
Ireland	McGettigan	ri, rn, ci, cn, ai, an, pi, sr	
Italy	Caponigro Dominicantonio	ri, rn, ci, cn, pi, sr an, pi	5
Luxembourg	Weber/Solanga	rn, ri	2
The Netherlands	Aben	ri, rn, ci, cn, ai, an, pi, sr	1
Norway	Kvæven	ri, rn, ci, an, pi, sr	
Russian Federation	Ryaboshapko	ri, ci, an, sr	
Slovak Republic	Babusik/Mitosinkova	ri, rn, pi, ia, sr	1
Slovenia	Lesnjak	ri, rn, ci, cn, ai, an, pi, ia, sr	2
Spain	De Pablo Ricote	ri, rn, ci, cn, ai, an, pi, ia, sr	2
Sweden	Boström	ri, rn, ci, cn	2
United Kingdom	Martin	ci, cn, ai, an, pi, sr	3

¹ ri/rn: regulatory international/national; ci/cn: compliance international/national; ai/an assessment international/national; pi :public information; ia : impact assessment; sr: scientific research

* national indicates regional in this case

5.2 Results for EU or EEA member states

Austria

The questionnaire was answered by the Federal Environmental Agency. Seven applications are mentioned:

- | | |
|--|----------------------------|
| 1. Air quality Protection Act (future) | (regulatory national) |
| 2. EMEP | (assessment international) |
| 3. GAW | (assessment international) |
| 4. Ozone law | (public information) |
| 5. Smog Alarm Act | (public information) |
| 6. Forest damage studies | (impact assessment) |
| 7. Pannonian Ozone Project | (scientific research) |

The requirements for these applications are summarised below:

app.	compounds	quant. @	time	dens.	scale	accur	delay	report
1.	SO ₂ ,PM,NO ₂ ,CO,O ₃	c	1/2h	280*	local/ regional	&	1/2h	daily
2.	SO ₂ ,NO ₂ ,NH ₃ ,CO SO ₄ S/N-dep, cations, metals	c dw	1/2h 1d 1d	3* 1 35	regional ,, ,,	& - -	1/2h 3m	annual annual
3.	O ₃ ,NO ₂ ,CO,CO ₂ , UV CH ₄ , NMVOC	c c	1/2h	1*	region./ cont. cont	&	1m	
4.	O ₃	c	1/2h	120*	urb./loc/ region.	2ppb	1/2h	d, m, an
5.	SO ₂ ,PM,NO ₂ ,CO	c	1/2h	#	urban/ local	&	1/2h	d
6.	O ₃ ,SO ₂ ,NO ₂ S, N, Heavy Metals	c dw	1/2h 1d	+ +	regional regional	- -		annual annual
7.	O ₃	c	1/2h	3*	regional			

* number of stations in Austria

dense network in Vienna and surroundings, Linz, Graz

+ 4 sites in Tyrol

& specified for various pollutants

@ c: concentration, dw wet deposition

In a later comment on a draft of this report, Austria pointed out that EC Directives now also apply as regulatory basis of air quality monitoring in Austria. In 1996, a monitoring network for benzene is being established on the basis of the projected Air Quality Protection Act.

Belgium

The questionnaire was returned by the Interregional Cell for the Environment CELINE-IRCEL.

Belgium indicated that in the application types, "national" should be replaced by "regional", referring to the three regions in Belgium: Flanders (F), Wallonian Region (W) and Brussels Region (B)

Applications mentioned are:

1. EC Air Quality Directives (regulatory international, public information)
2. Flanders regional relementation (regulatory "regional")
3. Exchange of Information Decision (assessment "regional")
4. Scientific research

Specifications provided were:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO2, NOx	c	1/2 h	35/11F	regional	1ppb; 1-2%	1/2-4h	d
	SPM (beta)	c	1h	8 F	local	25µg/m3	1-4h	d
	SPM	c	1/2h	3 F	local	±10%FS	1/2h-4h	d
	O3	c	1/2h	10F,2W	urban	1 ppb	1/2h-4h	d
2.	CO	c	1/2h	7 F	local	90ppb	1/2-4h	d
	VOC	c	1/2h	2B7F?W	urb/loc	10%?	1-2m1-2m	y
	PAH	c	24h	3F,1B?W	urb/loc	10%	nrt	y
	SPM	c	1/2h	3B,2W	urb/loc		4h	
	CO, CO2	c	1/2h	2B	urb	.2ppmCO 1ppmCO2	1m	
	SO2,NH3 SO4, NO3(part.)	c c	1d 1m	4B >1B	regional regional	1ppb	3m	
3.	O3,NOx,VOC	c	#	#	regional		#	#

* number of stations in region F, W or B

to be determined

@ c: concentration

Denmark

Denmark returned two questionnaires, both answered by the National Environmental Research Institute, one for urban air monitoring, and one for rural/background monitoring.

Applications mentioned for urban air monitoring are:

1. EU Directives and Council Decisions (regulatory international)
2. National regulations on SO₂, particulates, NO₂ and O₃ (regulatory national)
3. EU ozone Directive 92/72 and national regulation (public information)
4. Strategic Environmental Programme (not formal) (scientific research)

The requirements for these applications were specified by referring to a Technical Report and the Annual Report 1993, describing the current urban monitoring network. This information is summarised below:

appl	compounds	quant [@]	time	dens.	scale	accur	delay	report
1-4	NO,NO ₂ ,SO ₂ ,O ₃	c	1/2h		urban/ traffic		nrt	3- monthly
	meteo SO ₂ ,TSP, elements	c	24h		„			„

[@] c : concentration

Applications mentioned for rural/background monitoring are:

1. EMEP (regulatory and assessment international)
2. HELCOM (regulatory and assessment international)
3. OSPARCOM (regulatory and assessment international)
4. VMOP Action Plan on Aquatic Environment (regulatory and assessment national, impact assessment)
5. ECE ICP-Forests, level II (assessment international, impact assessment)
6. Ecosystems integrated monitoring programs (assessment national, impact assessment)

The requirements for these applications are specified by referring to tables with information on the background air monitoring in Denmark. This information is summarised below:

appl	compounds	quant [@]	time	dens.	scale	accur	delay	report
1-6*	O ₃	c	1/2h		regional		3- monthly	3- monthly
	NO ₂ , SO ₂ , NH ₃	c	24h		„		#	
	NH ₄ , NO ₃ +HNO ₃	c	24h		„			
	Na, Mg, K, elements	c	24h		„			
	NH ₄ , SO ₄ , NO ₃	dw	24h/2w		„			
	Cl, Na, Mg, K, H,	dw	24h/2w		„			
	PO ₄	dw	24h/2w		„			
	Cr, Ni, Cu, Zn, Cd, Pb	db	1m		„			
		db	1m		„			

*see for detail national report

4 months after quarter termination

[@] c: concentration, dw: wet deposition, db: bulk deposition

Finland

Two questionnaires were returned by the Finnish Meteorological Institute.

Applications mentioned were:

1. Monitoring of existing guidelines, Air Pollution Control Act (compliance national)
2. Monitoring of future guidelines, Air Pollution Control Act (compliance national)
3. EMEP (assessment international)
4. EGAP (assessment international)
(Group of Experts on Airborne Pollution of the Baltic Sea Area)
5. AMAP (Arctic Monitoring Assessment Programme) (assessment international)
6. GAW (Global Atmospheric Watch) (assessment international)
7. GO3OS (GAW Global Ozone Observation System) (assessment international)
8. O3 Directive (public information and alert)
9. TOR (EUROTRAC Tropospheric Ozone Research) (scientific research)

Requirements for these applications were specified as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , NO ₂ , CO, TSP	c	1h, 24h 1h,24h 1h,8h 24h	1-4/41 1-3/26 1-2/10 1-4/33	urban/ local		nrt/ 1m	1y
2.	SO ₂ , NO ₂ , NO _x , CO, TSP, PM ₁₀ , Pb, O ₃	c	1h/1d		region al/urba n/ local		nrt/1m	
3.	SO ₂ , O ₃ , NO _x , SO ₄ , NO ₃ , HNO ₃ , NH _x ions (EMEP)	c c c dw	1min- 1d	4	region al	var.	nrt; ≤ 3m	1y
4.	NO ₃ , NH ₄ , Pb, Cd, Cu, Zn	dw	1m	2	region al		6m	1y
5.	POP, HM	c,d	1w	5	global/ region al		1y 6m	1y?
6.	N ₂ O, CH ₄ , CO ₂ , CFC, HCFC, O ₃ NO _x , VOC, PAN, CO, SO ₂ O ₃ , NO ₂ ions	c c c\$ dw	1min-1w	1	global	var.	nrt/3m	1y
7.	O ₃ , SO ₂ , NO ₂ , OClO, UV	c\$	< 1h, 1-7/w	3	global	±5% ±1% ±10%	1w 1m nrt	
8.	O ₃ , rel. compounds	c	1h	9	region al		nrt	1m,1y
9.	O ₃ , NO, NO ₂ , VOC NO ₃ , met.	c(+d)	1-24h	1	region al		nrt 1m 6m	1y

* Application 1: sites per commune/number of communes; other applications: number of stations in Finland

\$ Total column; for O₃, concentration profile

@ c: concentration, dw: wet deposition

Germany

The questionnaire was answered by the Federal Environmental Agency. The Agency pointed out that - to their regret - information collected from the German States (Länder) was rather incomplete, as a consequence of the time constraints in answering the questionnaire.

In fact, three questionnaire responses were received, two from UBA-Berlin (drs. Schlegelmich and Kallweit), and one from UBA pilot station Offenbach (dr. Uhse)

The first nine applications from the following list were identified in the response by dr. Schlegelmich; he specified only applications 7 and 8, clearly assuming that specifications for international programmes are well-known (see chapter 3). Application 7 includes the requirements of the EC AQ Directives for SO₂, SPM, NO₂ and Pb.

The response by dr. Kallweit added to application 1. critical loads, (which we will not include in this report), compliance international for EMEP, HELCOM, and OSPAR (applications 1-3), national assessment reports (application 10.), and scientific research (notably on deposition).

For these, he provided specification for applications 1, 2, 3 (which are evidently not complete) and 10 only.

Dr. Uhse added application 11., for ozone only, mentioned EMEP, HELCOM, OSPAR, and GEMS and added applications on the Framework Convention on Climate Change, GCOS and GAW, which we combined in application 12. She mentioned also the smog alert system, (which we included in application 13., though it may fall under 7. and/or 8.), national assessment reports (10.) and scientific research (9.)

The applications identified were:

- | | |
|--|--|
| 1. EMEP (regulatory international) | |
| 2. HELCOM | (regulatory/compliance international) |
| 3. OSPAR | (regulatory international) |
| 4. Bilateral programmes (Black Triangle) | (regulatory international) |
| 5. GEMS | (regulatory international) |
| 6. OECD State of Environment | (regulatory international) |
| 7. National regulations | (regulatory national) |
| 8. State regulations | (compliance national, public information, impact assessment) |
| 9. scientific research | (scientific research) |
| 10. National assessment reports | (assessment national) |
| 11. EC O ₃ Directive | (regulatory international) |
| 12. FCCC/GCOS/GAW | (compliance international) |
| 13. Smog alert | (public information) |

As far as specifications were provided, these are summarised as follows:

appl	compounds	quant [@]	time	dens.	scale	accur	delay	report
1.	SO ₂ , NO ₂ , TSP, O ₃ , S in aerosol, ions in prec. metals	c c c dw c,dw	24h 1h 24h 24h 1w	ca. 200x200 km ²	regional	var.		2/y
7.*	SPM, SO ₂ , CO, NO, NO ₂ , NO _x , O ₃ , HF, HCl Pb, Cd org. comp.* SPM, Cd, Pb, Tl	c c d	1h,24h 24h 1m	var.	urban/ local, global	\$		d, y*
8.&	SPM, SO ₂ , CO, NO, NO ₂ , NO _x , O ₃ , HF, HCl, Cl ₂ , H ₂ S Pb, Cd org. comp.& SPM, Cd,Pb,Tl	c c d	1h,24h 24h 1m	var.	urban/ local, global	\$		d, y*
10.	"all measured compounds"	c, d	1/2h-1d	100x100 km ²	regional			
11.	O ₃	c	1h	100x100 km ²	regional	±2 µg/m ³	<2m	m
12.	CO ₂	c	1h	200x200 km ²	regional	0.2 ppm	<6m	2/y
13.	SO ₂ , TSP O ₃	c	1/2h	100x100 km ²	regional	3,20,2 µg/m ³	nrt	2/d

* Limited representation only; full specification in documentation provided; too extensive to report here. The German national network includes also measurements of HC, PAN, SO₄ and NO₃ in aerosol, B(a)P, benzene, toluene, xylene, and various other organic compounds.

& Limited representation only, full specification in documentation provided

\$ Specified in detail in German Regulation (TA-Luft, Verordnungen)

@ c: concentration; d: deposition; dw: wet deposition

Greece

The questionnaire was answered by the Ministry of the Environment
Three applications were mentioned:

1. EMEP (regulatory international)
2. EC Air Quality Directives (compliance national, international, assessment national)
3. Air Pollution episodes Athens/Salonica (public information)

The specification was given by specifying networks currently in place, in summary:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , NO ₂ , SO ₄ ions in prec.	c c dw	24h	1	regional			y
2/3.	SO ₂ , NO _x , CO, O ₃ , BS, TSP, PM ₁₀	c c c	1h/24h 1h 24h/1h	10-30	urban/ ind./traf/ region		nrt/5m	d/y

* number of measuring stations in Greece

@ c: concentration; d: deposition; dw: wet deposition

Ireland

The questionnaire was returned by the Environment Protection Agency.

Nine applications, referring to a number of frameworks were indicated, which we restructured in 5 application areas:

1. EC AQ Framework Directive and EoI Decision (regulatory international, assessment international)
2. National air quality standards, as based on EC Directives (regulatory national, compliance national, assessment national, public information)
3. EC AQ Directives (compliance international)
4. EMEP (assessment international, national)
5. GEMS (assessment international, national)
6. Council Reg. 3528/86 and 1613/89 (assessment international, scientific research)

For application 6., no further specification have been received; for the other applications, specifications were as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , BS, Pb NO ₂ , O ₃ VOC, PM ₁₀ , PAH	c c c c	1h/24h 1h 1h/24h 1h/24h	≤±50 5	urban		3m nrt	
2.	SO ₂ , BS Pb NO ₂	c c c	24h 24h 1h	60 8 5	urb/reg urban urban			
3.	SO ₂ , BS Pb NO ₂ O ₃	c c c c	24h 24h 1h 1h	60 8 5 5	urb/reg urban urban urb/reg		3m 3m nrt nrt	y,3y y,3y y,3y y,3y
4.	SO ₄ , NO ₃ , NH ₄ other ions; EMEP pollutants	dw c/dw	24h	5 2	loc/nat		6m	
5.	SO ₂ , BS NO ₂	c c	24h 1h	3 3	urban urban			

* number of stations in Ireland

@ c: concentration; d: deposition; dw: wet deposition

Italy

The questionnaire was answered by the Ministry of Environment. Supplementary information on UN-ECE programmes was received from ENEA via the Ministry.

Nine applications are mentioned:

1. Council Directives 80/779, 82/884, 85/203, 92/72 (regulatory international, compliance national, international)
2. Council Decision 82/459, 91/692 (compliance international, national)
3. National regulation
4. National regulation
5. Public information and alert
6. Scientific research
7. SINA AQ network (in implementation) (assessment national, public information)
8. EMEP (compliance international)
9. UN-ECE ICP materials and monuments (compliance international)

Specification of needs and requirements was as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , TSP, Pb NO ₂ , O ₃	c	24h 1h 1h	452-512 435 202	urban/ local urb/reg	&	nrt/1w/ 1m/4m \$	m/y
2.	see 1.	c	see 1.	see 1.	see 1.	&	see 1.	m/y
3.	CO NMVOC F	c	1h 3h 24h		urban/ local	&	nrt, 1w 1w, 1m 1w,1m	m/y
4.	benzene, PAH, PM ₁₀	c	1h 24h	cities [#]	urban	&	3m	3m,y
5.	SO ₂ ,TSP NO ₂ , O ₃	c	24h 1h	3-9 per city	urban/ local		nrt; TSP 24h	24h
6.	Ni, Cd acid comp. PAN, HCHO PCDD, PCDF	c	24h	volunt.	urban/ local		n.a.	3m
7.	various [%] SO ₂ , NO _x , TSP (EMEP)	c		173 36 12	urban industr. regional		1m,3m	y, 2y
8.	SO ₂ , NO ₂ , O ₃ EMEP ions	c dw	24h 1d	4 4	regional	EMEP crit.	EMEP crit.	y y
9.	SO ₂ , NO ₂ , O ₃ ions in prec.	c dw	1d 1w	4 4	global (?)	EMEP crit.	6m.	y

[@] c: concentration; d: deposition; dw: wet deposition

* unless otherwise specified, numbers of stations in Italy

& in accordance with national legislation

\$ depending on application

cities>150000 inhabitants

% "all primary and secondary pollutants", meteorological parameters

Luxembourg

The questionnaire was returned by the Administration of Environment, Department of Air/Noise. Two applications are mentioned:

1. EU Air Quality Directives, except Council Decision 82/459 (regulatory international /national)
2. Ozone Directive 92/72 (public information and alert)

The respondent states explicitly that for the international Conventions and agreements as listed in Annex 2 of the questionnaire, there is no relation with national monitoring networks and requirements (cf. chapter 3). In a clarification asked by telephone, the respondent explained that he considers it a task for EEA to elucidate the requirements from these conventions, and to propose European network structures, to which member states could contribute on a voluntary basis.

The respondent refers to the Annual Report (Rapport d'activité 1994) for specification of the requirements for these applications. This specification is summarised below:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , BS, NO ₂ dust Pb, Zn, SO ₄	c c d c	1h/24h 1h	5/8 5 50 4				y
2.	O ₃	c	1h	5			nrt	y

* number of stations in Luxembourg

@ c: concentration; d: deposition

Luxembourg also measures total hydrocarbons, methane, CO and CO₂.

The Netherlands

The questionnaire was returned by the National Institute of Public Health and the Environment.

Eleven applications are identified:

- | | |
|--|---|
| 1. National State of Environment reporting | (assessment national) |
| 2. National Air Quality Decrees | (regulatory national) |
| 3. Smog alert | (public information) |
| 4. Acidification | (compliance national) |
| 5. Deposition in semi-natural areas | (compliance national, international, scientific research) |
| 6. EC AQ Directives | (regulatory international) |
| 7. WHO Air Quality Guidelines | (compliance international) |
| 8. EMEP | (assessment international) |
| 9. OSPARCOM | (assessment international) |
| 10. EUROTRAC TOR | (scientific research) |
| 11. future needs | (assessment national) |

Specification was provided as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur ⁺	delay	report
1.	see appl. 2-11, plus: Fluoride O3 UV-B	c, dw c/d c&	var. 4w <1h <1h	var. 4 1 1-2	 reg/loc. global global		4m after year 1w nrt	y
2.	SO2, NO2, CO BS Pb benzene	c c c c	1h 24h 24h 1d,1w	40 14 3 10	regional/ urban/ traffic		nrt 4m after year	
3.	SO2 PM10 O3	c c c	1h 1h 1h	40 19 38	regional/ urban/ traffic		nrt	h
4.	SO2, NOx, NH3 ions in aerosol ions in prec.	c c dw	1h 24h 4w	30/26/8 8 14	regional/n ational/loc al		4m after year	y
5.	SO2, NOx, NH3 ions and metals in aerosol ions and metals in prec. S, -N-comp	c c dw dd ^{\$}	1h 24h 4w	30/26/8 8/3 14 2	regional/ national/l ocal		4m after year	y
6.	SO2, NO2, O3 BS Pb	c c c	1h 24h 24h	40/45/38 14 14	regional/u rban/ traffic		2w after month 4m a. y	y
7.	SO2, NO2, CO, O3 PM10 BS Cd, Pb benzene	c c c c c c	1h 1h 1h 24h 24h 1d,1w	40/45/22 38 19 14 14 10	regional/u rban/ traffic		2w after month 4m a. y	
8.	SO2, NO2, O3 NH3 SO4, NO3 ions in prec.	c c c dw	1h 1h 24h 24h	2 1 2 1	regional		4m after year	y
9.	N-compounds heavy metals α -, γ -HCH N-ions heavy metals POP	c c c dw dw dw	1h, 24h 24h 1d/1w 4w 4w 4w	2	regional		4m after year	y
10.	SO2, NO, NO2, O3, VOC, CO, CH4, CO2	c	1h	1	global/ regional		nrt	y
11.	C ₁ ⁶⁺ , PAH, acroleine	c	#	#	#	#	#	#

* number of stations in the Netherlands (40000 km²)

to be determined; scoping/scouting strategy likely

\$ dry deposition flux (micrometeorology)

& concentration profile, 2-12 km; 2-40 km

+ information to be supplied

@ c: concentration; d: deposition; dw: wet deposition

Norway

The questionnaire was answered by the Norwegian Pollution Control Authority.

Nine applications are mentioned:

- | | |
|---|------------------------------------|
| 1. EU Directives (incl. ozone) | (regulatory international, public) |
| 2. National legislation | (regulatory national) |
| 3. EMEP | (compliance international) |
| 4. OSPAR | (compliance international) |
| 5. AMAP | (compliance international) |
| 6. ECE-CLRTAP ICP forests/lakes and rivers | (compliance international) |
| 7. City monitoring | (assessment national) |
| 8. Terrestrial effects of Transboundary Pollution | (assessment national) |
| 9. Precipitation research | (scientific research) |

Detailed specifications, based on current station configurations, are given for some of these applications:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
2.	SO ₂ , PM ₁₀	c	24h		urban			
	NO ₂	c	1h					
3.	O ₃	c	1h	6	regional			
	SO ₂ /SO ₄ , NO ₂	c	24h	6/7				
	nitrates, totl. NH ₄	c	24h	7				
	S, N, ions, HM	dw	24h	6/4				
5.	POP, HM ^{&}	c	1w	1	regional/ global			
6.	O ₃	c	1h	4	regional			
	NO ₂	c	24h	3				
	SO ₂ /SO ₄ , nitrates	c	24h	5				
	totl. NH ₄	c	24h	4				
	Mg, Ca, K, Na, Cl	c	24h	1				
	S, N, ions, HM	dw	1w	12				
7.	NO _x , NO ₂	c	1h/24h	6	urban/ street			
	PM ₁₀ , PM _{2.5}	c	24h					

* number of stations in Norway

@ c: concentration; d: deposition

& Persistent Organic Pollutants (POP) include: PAH, HCH, HCB, PCB, Chlordane, Nonachlor, DDT, Dieldrin, Dioxins, Toxaphene. Heavy Metals (HM) include: Hg, Cd, Pb, Zn, Cu, As, Cr, Ni, Co, Mn, V.

Application 2. (national legislation, in preparation) will be based on calculations with models.

For some of the applications, the number of stations currently in use is specified:

appl.	3	4	5	6	7	8	9
No. stations	7	1	1	18	6	6	3

Spain

Response to the questionnaire came from the Ministry of Public Works, Transport and the Environment. The Ministry translated the questionnaire, and inquired all regional and local environmental departments, involved in air quality. This resulted in the return of 21 responses to the questionnaire, which are summarised as follows:

	ri	rn	ci	cn	ai	an	pi	ia	sr
Andalucía	*	*	*	*			*		
Aragón		*					*		x
Zaragoza	*	*			x	x	*	x	x
Asturias	*	*	*	*	x	x	*	x	x
Gijón	*	*	*	*	x	x	*	x	x
Mallorca	*	*	*	*			*	x	x
Canarias	*	*	*	*	x	x		x	
Cantabria	*	*		x					
Cast. de la Mancha	*	*	*	*		?	*		
Cast. y León	*	*	*	*	x	x	*	x	x
Valladolid	*	*	*	*		x	*		x
Cataluña	*	*	*	*		x	*	x	x
Galicia	*	*				*	*	x	x
Madrid, comm.	*	*	?					x	
Madrid, ayunt.	*	*	*	*		x	*	x	
Murcia	*	*		*		x	*	x	x
Cartagena	*	*		*		x	*	x	x
Navarra	*	*	*	*	x	x	*	x	x
País Vasco	*	*					*		x
Guipúzcoa	*	*	*	*					x
Valenciana	*	*	*	*	x	x	*	x	x

*: formally required

x: not formally required

In all questionnaires two applications were mentioned; with one exception, these were:

1. EC Air Quality Directives (regulation, compliance international; public information, impact evaluation)
2. National legislation and Decrees (regulation, compliance national, public information)

One response mentioned international agreements and conventions instead of application 2., but characterised it as "regulation national" and "compliance national", so this is possibly a mistake.

Not all respondents in Spain mentioned the same application categories.

Most respondents provided information on their requirement and needs on one sheet, combining the applications. The results are summarised in the table.

region	compounds	quant.	time	dens*	scale	accur.	delay	report
Andalucía	SO ₂ , NO _x , CO, O ₃ , HC, TSP	c	1/4h, 1/2h		urban/reg.		nrt, 24h	m, y
Aragón	SO ₂ , NO _x , SPM, O ₃	c	1/2-1h	14	reg.	1ppb	nrt/	2d
		c	1/4h	7	reg	1ppb	later	
Zaragoza	SO ₂ , NO _x , CO, O ₃ , H ₂ S, SPM, Pb	c	1/2-1h	7	urban/local		nrt	d, 3m, y
Asturias	SO ₂ , NO _x , CO, O ₃ , BS, HC, TSP, Pb	c	1/4h	10+33	urban/local	±5%	2h	y
Gijón	SO ₂ , NO _x , CO, O ₃ , BS, HC, TSP, Pb	c	1/4h	4+10	urban/local	±5%	2h	y
Mallorca	SO ₂ , NO _x , CO, HC, NMHC, TSP aerosol comp.	c, d	1/2h	1	urban/ind/tra	var	nrt/	3m
		c, d	1d		reg/gl		later ±1m	y
Canarias	SO ₂ , NO _x , O ₃ , BS, TSP, SPM, Pb	c	1/2h	5+7	region			y
Cantabria	SO ₂ , NO _x , H ₂ S, TSP	c	1/4h	3+0	urban/ind.	2µg/m ³		m, y
Cast. de la Mancha	SO ₂ , NO _x , NH ₃ , TSP, BS, SO ₂ , NO ₂ , Pb, SPM	c	6d	0+8	region			3m
		c	1/4h	4+0	local/ind.	ca 1µg/m ³	nrt later	
Cast. y León	SO ₂ , NO _x , CO, O ₃ , HC, TSP	c	1h	29	regi./urban	5%	nrt	m
Valladolid	SO ₂ , NO _x , CO, O ₃ , Pb, TSP	c	1/2h	7+0	urban	10%	nrt	d
Cataluña	SO ₂ , NO _x , CO, O ₃ , HC, VOC, TSP, PM ₁₀ , Pb, H ₂ S	c	1/4h	60+0	regio		nrt	
Galicia	SO ₂ , NO _x , CO, O ₃ , HC, TSP, H ₂ S	c	1h/24h	8+52	regio/urban		var, <1m	3m
Madrid, comm.	SO ₂ , NO _x , CO, O ₃ , BS, TSP	c	1/2h/1h	9+30	regio	±1%	nrt	1m
Madrid, ayunt.	SO ₂ , NO _x , CO, O ₃ , BS, SPM, Pb, CH ₄	c	1/2h	24	urban/local		nrt	d\$
Murcia	SO ₂ , NO _x , CO, O ₃ , BS, SPM	c	24/25 min.	1+8	regio	9%		y
Cartagena	SO ₂ , NO _x , CO, O ₃ , SPM, HC, HCl	c	1/2h/1h	11	urban/local		nrt	d
Navarra	SO ₂ , NO _x , SPM, TSP	c, d	1h/24h	1+11	urban/local	±10%	2h/1m	m, y
País Vasco	SO ₂ , NO _x , CO, O ₃ , TSP, HC	c	5min	1/100k m ²	regio/urban	1%	nrt	d, m
Guipúzcoa	SO ₂ , NO _x , O ₃ , CO, TSP heavy metals, org. compounds	c	1/4h	3+0	urban	1ppb	nrt	y
		c	24h			30ppb		
Valenciana	SO ₂ , NO _x , CO, O ₃ , BS, TSP	c	1/4h	22+44			2h	m, y

* current number of stations in the area, total or automatic + manual

\$ in elaboration

Sweden

The questionnaire was answered by the Swedish Environmental Protection Agency.
The following applications were mentioned:

1. EC AQ Directives (regulatory international)
2. National standards (regulatory national)
3. EMEP (compliance international)
4. HELCOM (compliance international)
5. OSPAR (compliance international)
6. Deposition N,S, metals (compliance national, international)

These applications are specified as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1,2.	SO ₂ , Smoke, PM ₁₀ ⁺ , NO ₂	c	1h,24h&	40	urban	\$	nrt, later	d, y
3.	S- and N-comp. Ions in prec. O ₃ , NO _y , VOC	c dw c	24h 24h 1h 2/w	6 4 4	regional regional regional			
4.	S- and N-comp. Ions in prec.	c dw	1m 1m	6 28	regional regional			
5.	S- and N-comp. Ions in prec. As, Cd, Cr, Cu, Hg, Pb, Ni, Zn	c dw dw	1m 1m 1m	6 28 2	regional regional regional			
6.	S- and N-comp. Cd, Cr, Fe, Pb, Ni, V, Zn, Hg	dt& dt#	1m 1/5y	32 ±1000	reg/loc reg/loc			

* number of stations (in application 1. and 2. cities) in Sweden

\$ in accordance with EMEP standards

+ in pilot phase

& throughfall

moss samples

@ c: concentration; d: deposition; dw: wet deposition

From the documentation on Sweden's monitoring programmes, provided with the questionnaire, it appears that Sweden also monitors CO₂, soot and particulate matter as climate related pollutants in the framework of IPCC/WMO, the ozone layer and UV-B radiation in the framework of WMO/UNEP, and is planning to monitor POP in air and precipitation in the framework of OSPARCOM. In its health-related programmes, VOC, PAH, soot, and carcinogenic substances are covered by survey measurements and campaigns.

United Kingdom

The questionnaire was answered by the Department of the Environment, EEA Focal Point. The following applications are mentioned:

1. Current and future EC Directives and daughter directives (compliance international). This application needs data for SO₂, NO₂, O₃, CO, Black Smoke, Pb, Ni, Cd, benzene, PAH, Acid deposition.
2. National air quality standards (including current EC Directives) (compliance national). This application needs data for SO₂, NO₂, O₃, benzene, 1,3-butadiene, lead, Black Smoke.
3. WMO/BapMoN, UN-ECE EMEP, CLRTAP, EUROTRAC/TOR (assessment international). This application needs data as provided by current rural networks, (networks 2,8 and 9 defined below).

All monitoring activities in the UK as specified in the following contribute to national assessment, public information, and scientific research.

Nine networks in the UK support these tasks. These are:

- | | |
|--|---|
| 1. Urban network | 6. Multi-elements and lead network |
| 2. Rural network | 7. Toxic Organic Micro Pollutants (TOMPS) network |
| 3. Hydrocarbon network | 8. Acid deposition network |
| 4. Smoke and SO ₂ network | 9. Rural SO ₂ network |
| 5. NO ₂ diffusion tube survey | |

The requirements for the applications are specified by the respondent along the lines of these networks. The specifications are:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	O ₃ , NO _x /NO ₂ , PM ₁₀ , CO, SO ₂	c	1h	25-80\$		± 10%	nrt	nrt,3-m,ann.
2.	O ₃ , NO ₂ , SO ₂	c	1h	18	regional	± 10%	nrt	nrt,3-m,ann.
3.	27 VOC species	c	1h	12	local/ urban	-	nrt	nrt,3-m,ann.
4.	Black Smoke, SO ₂	c	24h	252	urban/ industr.	±15 pgm ⁻³	1y	ann., month.
5.	NO ₂	c	1m	1100	urban/ traff.	-		ann.
6.	Pb, Cd, Cr, Cu, Fe, Mn, Ni, V, Zn	c	1w	21	local/ urban	± 10%		month
7.	dioxins, PAH, PCB	c/ d	1w/ 1m	5	region/ urban			
8.	NO ₂ cations, anions cations, anions	c db dw	1m 1m 1d	32 32 5	regional ,, ,,	± 10%	3m 3-6m 3-6m	ann. ,, ,,
9.	SO ₂	c(dd)&	1d	38	regional	± 10%	3m	ann.

* number of stations in UK

\$ in future (1997)

pollutant-specific values for accuracy and precision defined in questionnaire

& concentration used for calculation of dry deposition

@ c: concentration; d: deposition; dw: wet deposition; db: bulk deposition; dd: dry deposition

5.3 Results for other countries

Cyprus

The questionnaire was answered by the Department of Labour- Ministry of Labour and Social Insurance.

Applications mentioned were:

1. Control Atmospheric Pollution Law No 70/91 (regulatory/compliance national, public information)
2. EMEP; GAW (assessment international)
3. National assessment report (assessment national)

The requirements for these applications are specified as follows:

appl	compounds	quant [@]	time	dens.	scale	accur	delay	report
1.	NO/NO ₂ , O ₃ , SO ₂ , CO, PM ₁₀ , TSP, Pb	c c c	1h 1h 24h	100x100 m ²	local/ traffic	1-2%	nrt	annual
2.	NO ₂ , O ₃ , SO ₂ , CO ₂ , CH ₄ , PM, SO ₄ , HNO ₃ +NO ₃ , NH ₃ +NH ₄	c	1h 1/24h	*	region.	1-2%	nrt	3-monthly
3.#								

*"the whole of Cyprus" (no density given)

no further specification provided

@ c: concentration

Czech Republic

The questionnaire was returned by the Czech Hydrometeorological Institute. Three applications were mentioned:

1. National air monitoring (regulatory national, public information)
2. EMEP (regulatory international)
3. GAW (regulatory international)

For application 2, the only specification provided was that the complete EMEP-programme is carried out at 2 stations. No specification was provided for application 3.

Application 1 was specified as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , NO ₂ , NO _x , O ₃ , CO, TSP, PM ₁₀ ; TSP, heavy metals; ions, metals in precipitation	c	1/2h	74	local/ urban/ regional	1-2ppb; CO: 100ppb;	nrt;3m	y
		d?	3hTSP 1d 1m	14	urban/ regional	TSP: 5µg/m ³	3m	y
		dw	1m	9	urban/ regional		2m	y

* number of stations in Czech Republic

@ c: concentration; d: deposition; dw: wet deposition

Hungary

The questionnaire was answered and returned by the Ministry for Environment and Regional Policy.

Hungary expressed willingness to contribute to the EEA activities, but stressed a number of factors complicating the completing of the questionnaire, such as:

- responsibility for monitoring divided between many different institutes under different ministries;
- gradual installation of monitoring systems, often prompted by foreign donations;
- non-uniformity of monitoring stations;
- financial problems, causing problems in continuous operation of some monitoring networks.

Three applications are mentioned:

1. urban air quality (regulatory national)
2. smog alert system (public information and alert)
3. background air quality (impact assessment)

The requirements for these applications were specified as follows:

appl	comp.	quant. [@]	time	dens.	scale	accur.	delay	report
1.	SO ₂ , NO _x , CO, SPM	c	1/2h	84*	local	1ppb [#]	1d	-
2.	SO ₂ , NO _x , CO, SPM	c	1/2h	40*	urban		1/2h	-
3.	SO ₂ , NO _x , O ₃ aerosol ions in prec.	c dw	1/2h?1 d 1m	20*	region		1 w	-

* stations in Hungary

for SO₂

@ c: concentration; d: deposition; dw: wet deposition

Russian Federation

The questionnaire was answered by the Institute of Global Climate and Ecology.

Four applications are mentioned, all connected to the EMEP framework, and some also with the WMO Global Atmospheric Watch and EUROTRAC. This information can be summarised in one application:

1. EMEP (regulatory international, compliance international, assessment national, scientific research).

Specifications provided were:

appl	compounds	quant [@]	time	dens.	scale	accur	delay	report
1.	S-, N-comp., O ₃ , VOC, ions in prec.	c c dw	1d 1d 1d	g*	regional	10-30%	3m	y

* number of stations needed in European part of Russia

@ c: concentration; d: deposition; dw: wet deposition

The respondent, in contrast to many other respondents, refers to stations as needed, not to existing stations.

It is known by the authors that the Main Geophysical Observatory, St. Petersburg, collects air quality data for Russian cities since a 1992, and has been collecting such data from 1965 for cities in the former Soviet Union. The current practice is described in Sluyter et al. (1995); pollutants monitored include TSP, SO₂, CO, NO₂, and in many cities B(a)P, hydrogen sulphide, phenol, hydrogen fluoride, and formaldehyde as well. Samples are taken 3-4 times a day, each during 20-30 min. These data no doubt are needed or required in Russia.

Slovakia

The questionnaire was answered by the Slovak Hydrometeorological Institute.
The following applications were mentioned:

1. EU Air Quality Directives (planned) (regulatory international)
2. EMEP (regulatory international)
3. Air Protection Act 309/91 (regulatory national)
4. Smog alert system (public information and alert)
5. Environmental Impact Assessments (impact assessment)
6. Input data providing (scientific research)

These requirements are specified by a short description of two Slovak Networks:

1. National Local automatic network
2. National regional background

Specification is as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , NO _x , O ₃ , TSP, CO	c	cont.	30	local	&	nrt	d, y
2.	\$	\$	\$	7	regional	\$	1m	2/y

* Number of stations in Slovakia (49000 km²)

\$ According to EMEP specifications

@ c: concentration

From the document provided with the response, it can be seen that information to the public is explicitly required under Slovak legislation, as is annual reporting of air quality and on contributions from individual sources.

Slovenia

The questionnaire was answered by the Hydrometeorological Institute of Slovenia.
Applications identified are:

1. EMEP (regulatory international, compliance international, assessment international; also for national assessments)
2. MEDPOL (the Co-ordinated Mediterranean Research and Monitoring Programme under the Barcelona Convention) (regulatory international, assessment international; also for national assessments)
3. GAW (Global Atmospheric Watch) (assessment international; also for national assessments)
4. National Environmental Protection Act (regulatory national, compliance national, assessment national, impact assessment; also for international programmes)
5. Public information (also for national assessments)
6. Bilateral agreements; research programmes (scientific research; also for national assessments and international programmes)

Specification of the requirements and needs is as follows:

appl	compounds	quant [@]	time	dens.*	scale	accur	delay	report
1.	SO ₂ , NO ₂ , O ₃ , HNO ₃ , NH ₃ SO ₄ , NO ₃ , NH ₄ , heavy metals VOC, POP ions (EMEP)	c c c dw	1h/24h 24h 24h	1-2	regional	&		2/y
2.	ions, heavy metals in prec. TSP, metals	dw c	24h 24h	1-2	regional	&		y
3.	O ₃ , CO, CH ₄ , SO ₂ , NO, NO ₂ aer.; ions in aer. ions in prec.	c c dw	1h 1h; 24h 24h	1-2	regional	&		1-6/y
4.	NO ₂ , O ₃ , CO, SO ₂ , BS TSP Cd, Pb, Mn, V TSP, Cd, Pb, Zn, H ₂ S, CS ₂ , HF, HCl Org. Comp. §	c c c d c c c	1/2hCO 1h 24h 24h? ? 1/2h 1h 1/2-24h	40-50 [#]	urban/ local	±10%	nrt later " " " "	m, y
5.	O ₃ , CO, NO ₂ , SO ₂ , TSP	c	3h	#	urban/ local	±10%	nrt	d
6.	aer.; ions in aer. acid. comp., heavy metals	c dw	24h 24h	1	regional	&		1-6/y

* number of stations in Slovenia

& according to EMEP/MEDPOL/GAW specifications

no requirements on density in Slovenian regulations

§ 1,2 dichloroethane, dichloromethane, tetrachloroethene, trichloroethene, formaldehyde, styrene, toluene.

@ c: concentration; d: deposition; dw: wet deposition

5.4 Overview of results

The following table provides an overview of the monitoring functions reported by the countries.

State	ri	rn	ci	cn	ai	an	pi	ia	sr
Austria		*			*		*	*	*
Belgium	*	*				X	X		X
Cyprus		*		*	*	*	*		
Czech Republic	*	*					*		
Denmark	*	*			*	*	*	*	X
Finland				*	*		*		*
Germany	*	*	*	*		*	*	*	*
Greece	*		*	*		*	*		
Hungary		*					*	*	
Ireland	*	*	*	*	*	*	*		X
Italy	*	*	*	*		*	*		*
Luxembourg	*	*							
The Netherlands	*	*	X	*	*	*	*	*	*
Norway	*	*	*			*	*		*
Russian Federation	*		*			*			*
Slovak Republic	*	*					*	*	*
Slovenia	*	*	*	*	*	*	*	*	*
Spain	*	*	*	*	X	X	*	X	X
Sweden	*	*	*	*					
United Kingdom			*	*	*	*	*		*

x: no formal requirement

ri/rn: regulatory international/national;

ci/cn: compliance international/national;

ai/an assessment international/national;

pi :public information;

ia : impact assessment;

sr: scientific research

The following tables provide overview of the pollutants as referred to in the responses. The overview is not complete, as countries report measurements for other components, such as HNO₃, HF, HCl, CS₂, and others, and countries obviously are interested in specific metals, volatile organic compounds, and persistent organic pollutants. It is possible, that the authors may have overlooked some explicit or implicit requirement or need in the sometimes extended information sent with the responses.

Compounds under the draft EC Framework Directive

State	SO2	NO2	SPM	Pb	O3	benz.	PAH	CO	Cd	As	Ni	Hg
Austria	x	x	x		x	x		x				
Belgium	x	x	x		x		x	x				
Cyprus	x	x	x	x	x			x				
Czech Republic	x	x	x		x			x				
Denmark	x	x	x	x	x				x	x	x	
Finland	x	x	x	x	x			x				
Germany	x	x	x	x	x	x	x	x	x	x	x	x
Greece	x	x	x		x			x				
Hungary	x	x	x		x			x				
Ireland	x	x	x	x	x		x					
Italy	x	x	x	x	x	x	x	x	x		x	
Luxembourg	x	x	x	x	x			x				
The Netherlands	x	x	x	x	x	x	x	x	x	x		
Norway	x	x	x	x	x		x		x	x	x	x
Russian Federation	x	x	x		x		x	x				
Slovak Republic	x	x	x		x			x				
Slovenia	x	x	x	x	x			x	x	?	?	?
Spain	x	x	x	x	x			x	?	?	?	?
Sweden	x	x	x		x		x					
United Kingdom	x	x	x	x	x	x	x	x	x		x	

Other compounds under the draft Exchange of Information Decision

State	NO	PAN	VOC	but.	for.	tol.	styr.	acr.	NH3	H2S	Cr	Mn	C _x Cl _y
Austria	x		x						x	x			
Belgium	x		x						x				
Cyprus	x												
Czech Republic	x												
Denmark	x								x		x	x	
Finland	x	x	x										
Germany	x	x				x				x			
Greece	x												
Hungary	x												
Ireland	x		x										
Italy	x	x	x		x								
Luxembourg	x		x										
The Netherlands	x							x	x		x		
Norway	x	?	x						x			x	
Russian Federation			x		x					x			
Slovak Republic	x												
Slovenia	x		x		x	x	x		x	x		x	x
Spain	x		x						x	x			
Sweden	x		x										
United Kingdom	x		x	x		x	x				x	x	

Compounds in precipitation and in aerosols (for metals in aerosols, see previous tables)

State	cond. prec	H ⁺ prec	SO ₄ ⁻ prec	NO ₃ ⁻ prec	NH ₄ ⁺ prec	cations prec.	HM prec	POP prec.	SO ₄ ⁻ aer	NO ₃ ⁻ aer	NH ₄ ⁺ aer	POP (*)
Austria			x	x	x	x	x		x			
Belgium		x	x	x	x	x			x	x	x	
Cyprus			x	x	x				x	x	x	
Czech Republic	x	x	x	x	x	x	x		x	x	x	
Denmark	x	x	x	x	x	x	x		x	x	x	
Finland	x	x	x	x	x	x	x	x	x	x	x	
Germany	x	x	x	x	x	x	x	x	x	x	x	
Greece	x	x	x	x	x	x			?	?	?	
Hungary	x	x	x	x	x	x			x	x	x	
Ireland	x	x	x	x	x	x	x	x	x	x	x	
Italy	x	x	x	x	x	x						
Luxembourg												
The Netherlands	x	x	x	x	x	x	x	x	x	x	x	
Norway	x	x	x	x	x	x	x	x	x	x	x	x
Russian Federation	x	x	x	x	x	x	?	?	x	x	x	
Slovak Republic	x	x	x	x	x	x			x	x	x	
Slovenia	x	x	x	x	x	x	x		x	x	x	
Spain												
Sweden	x	x	x	x	x	x	x	x	x	x	x	x
United Kingdom	x	x	x	x	x	x		x	x	x	x	x

(*): gas and aerosol

Gases related to climate change and global tropospheric and stratospheric ozone

State	CO ₂	N ₂ O	CH ₄	CFC	HCFC	O ₃ t	O ₃ s	NO _x	VOC	CO	UV
Austria	x		x			x		x	x	x	x
Belgium	x										
Cyprus	x		x								
Czech Republic											
Denmark											
Finland	x	x	x	x	x	x	x	x	x	x	x
Germany	x	x	x					x	x	x	
Greece											
Hungary											
Ireland											
Italy											
Luxembourg			x								
The Netherlands	x		x			x		x	x	x	x
Norway											
Russian Federation*											
Slovak Republic											
Slovenia			x				x	x		x	
Spain											
Sweden	x						x				x
United Kingdom							x	x	x	x	

* GAW indicated without further specification

6. DISCUSSION AND CONCLUSIONS

Air quality monitoring requirements have been reviewed from four types of information sources, each with certain limitations.

The monitoring requirements in **CEC Directives and Decisions** (both the current Directives and the future Daughter Directives under the Framework Directive) are specified in detail in many aspects. The legal framework is well suited for enforcing harmonisation and quality documentation of the monitoring efforts. Although the EC legislation formally applies to EU Member States only, other European countries tend to adopt guidance from this framework. The main weak point here is the lack of definition of the assessments and assessment quantities that are really needed for policy support, and the lack in harmonisation in assessment methods.

In contrast, the monitoring requirements in **international conventions and agreements** are often phrased in rather general and broad terms, and there are few formal or detailed obligations for monitoring. However, strong assessment communities have been developed in interaction with policy needs, and harmonised monitoring has been strongly stimulated as a result of this.

The monitoring requirements for **European assessment reports** with regard to air quality have generally not been met, as far as explicit requirements have been formulated. Rather, the assessment have been made on the basis of available and accessible information, which strongly limited the scope and reliability of these assessments. In view of the lack of accessible and comparable monitoring information, model estimates have often been used instead.

Information on the monitoring requirements of **European states** has been collected for this review by means of a questionnaire. The response was high, in particular from EEA member countries. The functions of monitoring, as described in the introduction, seem to be a source of some confusion: terminology such as regulatory, compliance, or assessment-oriented monitoring was used differently for the same application by the member countries. Rather than to needs and requirements, respondents often referred to existing monitoring systems. In these cases, it is unclear whether these countries have needs that are not covered by their current networks.

Some monitoring applications or frameworks, such as EMEP and GAW, were not mentioned by all states which are known to contribute to these programmes. This is probably a consequence of the strong tendency in the EU to limit the field of air quality to "classical" pollutants and to urban and local scales. Both from a practical and logistic view, and for more fundamental reasons, it is recommended to consider all air quality monitoring efforts in a coherent way; most of these measurements share monitoring stations, maintenance and quality assurance procedures, and reporting requirements are often similar.

From this study, it is apparent that information is needed for a large number of pollutants, even exceeding the list of 37 pollutants now annexed to the draft Exchange of Information Decision. Information is needed for oxidised and reduced sulphur and nitrogen compounds,

ozone, carbon monoxide, particulates, a variety of volatile organic compounds, various toxic organic compounds including polycyclic aromatic hydrocarbons, a series of metals, persistent organic pollutants, greenhouse gases, such as carbon dioxide, dinitrogen oxide, methane, tropospheric ozone, aerosols, and chlorofluorocarbons and related chemicals, and other pollutants, as well as radiation characteristics. Information is needed on ambient air concentrations, as well as on wet and dry deposition for many of these pollutants, and others. In some cases, information is needed on vertical concentration profiles, or column-integrated concentrations. Achievable and required averaging times for these quantities range from minutes to annual averages.

In increasing part of this information is formally required in legislation and international conventions, or needed for international assessment programmes.

Many of these needs are to be met not only by EU member states, but also - by free choice - by other European countries, such as EEA current and future members, and partners to various conventions, such as the CLRTAP and the Framework Convention on Climate Change. It is considered natural and efficient to make these data accessible to more, and preferentially to all European States, and invite these to contribute to information systems that make this information available.

From various assessments reviewed in this report, it is evident that there is still a considerable lack of recent, harmonised monitoring information of sufficient coverage and quality to serve for European air quality assessments. At the same time, there has been so far not much explicit formulation on the accuracy with which various assessment quantities, such as concentrations, depositions, exposure, areas of exceedance, are required. This is important input information for network design.

As the cost, human capacity and expertise needed for monitoring is appreciable, there is not much point in formulating requirements as such, leaving it to the European states to implement these. Instead, monitoring requirements should be defined after an evaluation of current monitoring efforts, in order to show where adjustments can be made in the most cost-effective way. This should be carried out in close co-operation with the states, that are carrying out the monitoring, as is the practice in the development of EU air quality legislation. Also, it cannot be expected that monitoring requirements can be formulated that stand for a very long period of time; rather, a continuous process of evaluation and re-adjustment of monitoring efforts is recommended. It is evident, that this dynamic process should not jeopardise long term monitoring series for trend detection.

The results of air quality monitoring should be integrated with results of other monitoring efforts directed to other environmental compartments, to targets at risk such as human health, ecosystems, and to economic sectors, where the causes of poor air quality are to be documented and quantified.

The key to this is assessment in its wider meaning: evaluating, analysing and quantifying air pollution concentrations, depositions and exposures with regard to causes, sources and underlying human activities at the one hand, and with regard to impacts and effects on health, ecosystems, materials, cultural heritage, climate etc. at the other hand. Assessment of air quality in this sense is necessary as a basis for policy development and implementation and air quality management.

It is recommended that assessment, in this meaning, should be a major guiding principle for prioritising and restructuring air quality monitoring activities. Monitoring efforts should not

be undertaken unless it is clear what the contribution of these efforts to assessments is, and how and by whom the assessment on the basis of the monitoring data will be carried out, in response to explicit policy needs. Assessing air quality in Europe, on the basis of sound monitoring efforts, is a major task for EEA.

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ANNEX 1: QUESTIONNAIRE

Questionnaire 1

Air quality monitoring: requirements and needs

According to the Annual Work Programme Mid 1994-1995 of the EEA, programme 4, media-oriented monitoring, project MA1, the European Topic Centre for Air Quality is reviewing requirements and needs for air quality monitoring in the EU and in member states as part of a more extended review. We ask you on behalf of EEA to help us by completing this questionnaire.

This questionnaire is addressing the requirements and needs your country has for monitoring, now and for the next few years, regardless of what monitoring networks are already in place, or being planned. In a next questionnaire in this package, the monitoring activities that are actually carried out are addressed.

If appropriate, please refer to published documents. In case of reference to national documents or documents with restricted dissemination, please send copies of the relevant parts for our information.

For clarification of terminology, a short explanatory note on air quality monitoring is attached as Annex 1.

We appreciate that answering may involve consultation of National Reference Centres or other centres of expertise. However, in view of the tight time schedule laid down in the Work Programme, we ask you to send back the completed questionnaire **by 10 March 1995** at the latest to:

European Topic Centre on Air Quality
RIVM
P.O.Box 1, NL 3720 BA BILTHOVEN
The Netherlands

If you need clarification, please contact:

dr. Roel M. van Aalst
tel +31 30 742884
fax +31 30 287531
e-mail aalst@rivm.nl

1. Please give name and address of person answering this questionnaire

Name
Function
Organisation
address
telephone
fax
e-mail

2. For which applications does your country, **in the next few years**, have to meet formal (legal or regulatory) national or international requirements for air quality monitoring, or for which applications do you need such monitoring for other reasons?

Please identify each of these applications by a number, and indicate the framework in which the application is needed. For your convenience, a list of examples for such frameworks is given in Annex 2. Note that this question also applies to needs which have not yet been met in existing or planned monitoring networks.

If the answer is included in reports or documents, send copies of these to us.

	application nr.	formal requirement	framework (see annex 2)	other needs	framework (see annex 2)
regulatory international	..	y/n	.....	y/n	.....

regulatory national	..	y/n	.....	y/n	.....

compliance international	..	y/n	.....	y/n	.....

compliance national	..	y/n	.....	y/n	.....

assessment international	..	y/n	.....	y/n	.....

assessment national	..	y/n	.....	y/n	.....

public information and alert	..	y/n	.....	y/n	.....

impact assessment	..	y/n	.....	y/n	.....

scientific research	..	y/n	.....	y/n	.....

3. For **each** of these applications, to be identified by number (see question 2), please specify as far as possible the monitoring information as required or needed, according to the following list. Copy this form for each application.

Note: there is no need to answer this question if the answer is available in documents or reports. In this case, provide copies to us.

Application number: ...

- chemical species, compounds or compound groups
- quantity (concentration, deposition, exposure)
- time average/ time resolution
- spatial density
- representativity for global scale/regional scale/urban scale/local scale (industrial, traffic)
- accuracy and precision
- availability (near real time or delayed); maximum allowable delay time
- reporting requirements: target group, reporting frequency, maximum allowable delay time
- others.

Annex 1

Air quality monitoring

Air quality monitoring may be defined as the systematic collection of information from measurements or other means to determine the levels and the time evolution of quantities relevant to air quality, and the reporting of these quantities. Such quantities are air concentrations, deposition fluxes of air pollution to land and water surfaces, and the exposure to air pollution of human beings, materials and ecosystems.

Although measurements form an important aspect of monitoring, measurements alone are rarely sufficient to arrive at the best possible description of the desired concentrations and other quantities. Models are often used to interpolate and generalize measured information, or to generate best estimates in situations where measurements are lacking or cannot be made.

Functions of monitoring and applications of monitoring results may be manifold:

- regulatory: monitoring as part of legal or regulatory obligations, often derived from more general objectives, such as protecting human health, or ecosystems.
- compliance monitoring: monitoring to verify the achievement of goals (e.g. air quality guidelines) formulated in international conventions and other agreements, and in national policies.
- assessments for policy support: monitoring as a means to provide information and to produce assessments in support of development, formulation, implementation and evaluation of environmental policies.
- impact assessment: monitoring to determine exposure to air pollution and the resulting impacts and effects on human health, ecosystems, materials, and on other environmental compartments.
- public information and alert: monitoring to provide factual information to the public, as a basis for avoiding excessive exposure to air pollution
- scientific research: monitoring to answer scientific questions, to elucidate atmospheric processes, and to verify and validate atmospheric models.

The requirements for monitoring with regard to spatial and temporal representativity and accuracy may differ considerably depending on these functions.

Annex 2

Some frameworks for monitoring requirements

Note: this list does not pretend to be complete!

EU Air Quality Directives:

- Council Directives 80/779, 82/884 and 85/203 on air quality standards or limit values for respectively SO₂/ suspended particulates, lead, and NO₂;
- Council Directive 92/72 on air pollution by ozone;
- proposed Council Directive on Ambient Air Quality Assessment and Management (Framework Directive on Ambient Air Quality), COM(94) 109 final.
- Council Decision 82/459 (superseding 75/441) on exchange of information on air pollution
- proposed Council Decision on Exchange of Information on Air Pollution

International Conventions and agreements:

- Convention on Long-range Transboundary Air Pollution (Geneva, 1979):
 - EMEP Co-operative Programme (Geneva, 1984)
 - Sulphur, Nitrogen oxides, VOC protocols (Helsinki, Geneva, Sofia, Oslo)
- Framework Convention on Climate Change (New York, 1992)
- Convention on protection of the ozone layer (Vienna, 1965):
 - Protocol on substances that deplete the ozone layer (Montreal, 1987)
 - Amendments London (1990), Copenhagen (1992)
- Convention on Protection of the Marine Environment of the Baltic Sea Area (Helsinki, 1974;1992)
- Oslo and Paris Conventions for the prevention of marine pollution (1972,1974, 1992) (INPUT Working Group)
- Convention on protection of the Mediterranean Sea against pollution (1976)
- Convention on early notification of a nuclear accident (Vienna, 1986)
- Convention on transboundary effects of industrial accidents (Helsinki, 1992)

Bilateral agreements, agreements between neighbouring countries or provinces (not specified. Example: Black Triangle PHARE Regional Programme)

Monitoring frameworks:

UN-ECE Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP)
WHO/UNEP Global Environmental Monitoring System (GEMS)
WMO/IOC/ICSU/UNEP Global Climate Observing System (GCOS)
WMO Global Atmospheric Watch (GAW), Background Air Pollution Monitoring Network (BapMoN), Global Ozone Observing System (GO₃OS)

Assessment studies:

- “Europe’s Environment”: the Dobriř assessment, and consecutive European state-of-environment reports
- “Concern for Europe’s Tomorrow”, and consecutive European State-of-environment and health reports
- OECD The state of the environment reports
- WMO/UNEP IPCC assessment reports
- WMO/UNEP Scientific assessment reports on ozone depletion
- national assessment reports

ANNEX 2: COVER LETTERS AND MAILING LIST OF QUESTIONNAIRE

European Topic Centre on Air Quality under contract to the European Environment Agency RIVM-NILU-NOA-DNMI

To: EEA National Focal Points and National Reference Centres on air quality

Bilthoven : 17 February 1995
Our number : 1077/95 LLO vA/hk
Subject: questionnaires

Telephone : +31-30-742884
Fax : +31-30-287531

The EEA Topic Centre on Air Quality has now started its work according to the Annual Work Programme mid-1994-1995. A Work Plan 1995 will be presented to you at the meeting of National Focal Points on February 20, at Copenhagen.

Important in this early stage is:

- reviewing available information on future monitoring requirements and additional needs and on current monitoring practice (project MA1),
- reviewing current database systems and evaluating experience in EU Exchange of Information and other international data collection on air quality (project MA2), and
- reviewing requirements on models and model applications (project MA-3).

In this process, we are using available reports, documents and information systems as much as possible. Nevertheless, we need additional input from you for a number of reasons.

First, we need to collect information that is as up to date as possible and we need to take into account what is **foreseen** to be needed for the next few years.

Secondly, in the present review it is attempted to cover all efforts in EEA Member States and in the Pan-European states for monitoring and modelling on all spatial scales, including local, national, continental and global scales. This is needed to provide a basis for air quality assessment studies in support of periodical reports on the state of the environment in Europe, as foreseen in the Work Programme, programme 2 (PR).

For these reasons, we ask you to help us and fill in a number of questionnaires, which are attached.

The first questionnaire, coded MA1-1, addresses **future requirements and additional needs for monitoring**, now and in the next few years. We may assume that formal requirements as laid down in EU legislation are met or are planned to be met in EU member states; however, we would like to include your additional needs for monitoring information, regardless of whether these needs are met in current monitoring networks. Please send us copies of existing reports if you feel that these cover the questions in this questionnaire.

The second questionnaire, coded MA1-2, addresses **current monitoring practice**. Particularly for EU Member States, much information is already available and will be used. Please send us copies of existing reports if you feel that these cover the questions in this questionnaire.

This questionnaire is largely identical to the questionnaire of the WHO Survey of National, Regional and Local Air Monitoring Networks of the WHO with its Collaborating Centre for Air Quality Management and Air Pollution Control (WaBoLu, Berlin) and the European Centre of Environment and Health (WHO-ECEH, Bilthoven). In view of the fact that almost identical information as needed for the EEA Topic Centre on Air Quality was requested by the WHO, the two organisations are collaborating and co-ordinating their efforts. All information collected in these questionnaires will be available to both organisations.

A third questionnaire, coded MA2-1, reviews **the use of the EU databases APIS and GIRAFE**. This questionnaire has been sent to the users of APIS and GIRAFE, with a copy for your information that will be sent to you by separate mail.

An additional questionnaire addressing the **data supplying to APIS and GIRAFE** is still under development.

The fourth questionnaire, coded MA3-1, is addressing **requirements for models and model applications**.

We understand that you may have appointed National Reference Centres on air quality in answering the questionnaires; where this is the case we have also sent questionnaires directly to those NRCs. As our information on this is still incomplete, I would be grateful if you could confirm if there is a relevant NRC on air quality in your country.

We highly appreciate your input and guidance in this important initial stage, and ask you to return the questionnaires by 10 march 1995 at the latest to the return addresses as indicated. Please feel free to contact me on any further details, or if you have any difficulties in completing the questionnaire and returning it according to the time schedule.

Yours sincerely,

dr. Roel M. van Aalst
Project leader of the
European Topic Centre on Air Quality

Encl(s): 4

European Topic Centre on Air Quality
under contract to the European Environment Agency
RIVM-NILU-NOA-DNMI

To: National contact points on air quality in European countries

Bilthoven : 28 February 1995
Our number : 1086/95 LLO vA/hk
Subject : questionnaires

Telephone : +31-30-742884
Fax : +31-30-287531

This letter is to inform you on current developments in the European Environment Agency (EEA) with regard to air quality, and to inquire after your interest to contribute to these developments. Note that this is an informal request, as relations between EEA and your country have not yet been formally established. Your country may expect to receive a more formal request at a later stage.

As you may know, the European Environmental Agency has recently been starting its work. A newsletter (attached) may serve to inform you on the tasks and structure of the Agency. The Agency is currently carrying out its Work Programme 1994-1995, in close cooperation with its 17 member states, represented by National Focal Points. European Topic Centres, working under contract to the Agency, assist in the processing of thematic data (air, water, nature, etc.) or carry out specific assessments of a European character.

As project leader of the EEA Topic Centre for Air Quality, I have the pleasure to inform you on our Work Plan 1995, which is attached. Our goal is to support EEA in all its tasks related to air quality and atmospheric deposition; and we aim at collecting, processing and using information that is needed for air pollution assessments and air quality management in the most effective way. As you can see, we plan to review and evaluate in 1995 current European efforts in monitoring, modelling and information management of air quality, with the aim of recommending and implementing improvements in the European air quality infrastructure. In this work, we would prefer to take a Pan-European approach whenever possible. We are grateful for any comments or suggestions you may have with regard to the Work Plan.

As part of this effort, we are currently sending out questionnaires to obtain information on the requirements and needs of European countries as well as on the actual situation in these

countries regarding air quality monitoring, modelling and data systems. We are cooperating here with various international frameworks, such as the European Commission, UNECE-EMEP, and the WHO, which provided us with your name.

We would appreciate very much if you would decide to join in to our current effort and fill in these questionnaires. We think that it would be very valuable to include the experience and the views of all European countries in this.

We are aware that the current time schedule in our work programme, requiring completing the questionnaires by March 10, is very tight. In view of the date of sending you this information this would practically not allow you to contribute. We would be grateful to receive your response by **March, 24**, if this is possible.

Please do not hesitate to contact me if any clarification is needed or if you have any difficulties in completing the questionnaire.

Of course, we will keep you informed on the results of these questionnaires and, more generally, on the progress of the work in our European Topic Centre.

Yours sincerely,

dr. Roel M. van Aalst
project leader,
EEA European Centre on Air Quality

Enclosures:

- EEA Newsletter
- Work Plan 1995 ETC AQ
- Questionnaires, cover letter, distribution lists

**Mailing list of questionnaires sent by
Topic Centre for Air Quality**

National Focal Points

Mr. G. Liebel, Umweltbundesamt, Austria
Mr. A. Derouane, ICE Brussels, Belgium
Mr. T. Iversen, NERI, Denmark
Mr. T. Säynätkari, National Board of Waters and Env., Finland
Mr. J-L. Weber, IFEN, France
Mr. K. Tietmann, UBA, Germany
Mrs. Aravantinou, Ministry for Env. Physical Planning, Greece
Mr. T. Ibsen, Ministry for Env., Iceland
Mr. L. Stapleton, Env. Prot. Agency, Ireland
Mrs. C. Pera, Ministero dell' Ambiente, Italy
Mr. J-P. Feltgen, Min. de l'Env., Luxembourg
Mr. A. Minderhoud, RIVM, The Netherlands
Mrs. B. Kvæven, Statens Forurensningstilsyn, Norway
Mrs. M.L. Gomes, Min. do Ambiente, Portugal
Mr. A. Herrero, MOPT, Dir. de Political Ambiental, Spain
Mrs. C. E. Boström, Swed. Env. Prot. Agency, Sweden
Mr. C. D. Martin, Dept. of Env., United Kingdom

Questionnaires that have been sent, i.e.: MA1-1, MA1-2, MA2-1, MA3-1

Non - EEA member countries

Mr. L. Selfo, Committee for Preservation and Protection, Albania
Mr. O. N. Ivanov, Min. for Foreign Affairs, Belarus
Mr. I. Filipov and Mr. V. Kandev, Min. of Environment, Bulgaria
Mrs. M. Mastrovic, Min. of Civil Engineering, Croatia
Mrs. S. Vidic, Div. Meteorological and Hydrological Service, Croatia
Mr. N. Georgiades, Min. of Agriculture and Nat. Resources, Cyprus
Mr. L. Nicolaidis, Env. Pollution, Cyprus
Mr. L. Saare, Min. of the Environment, Estonia
Mr. L. Haszpra, Hungarian Meteorological Service, Hungary
Mr. N. Zoltai, Dept. of Environmental Policy, Hungary
Mr. V. Vilnitis, Min. of Env. Protection, Latvia
Mr. I. Kikis, Head of Foreign Relations, Env. Prot. Dept., Lithuania
Mr. F. Näscher, Landesforstamt, Liechtenstein
Mr. L. Micallef, Min. of Environment, Malta
Mr. D. Drumea, Moldavian Dept. Env. Prot., Moldova

Non - EEA member countries

Mr. P. Blaszyk and Mr. G. Mitosek, Inst. of Env. Prot., Poland
Mrs. A. Gheorghe, Min. of Waters, Forestry and Env. Protection, Rumania
Mr. D. Kolganov, State Inst. for Applied Ecology, Russian Fed.
Mr. A. Ryaboshapko, Inst. of Global Climate and Ecology, Russian Fed.
Mrs. M. Mitosinkova, Slovak Hydrometeorological Inst., Slovakia
Mr. D. Svihlová, Min. of Env., Slovakia
Mr. J. Hodalic, Env. Prot. Agency, Slovenia
Mrs. M. Lesnjak, Hydrometeorological Inst., Slovenia
Mr. R. Gehrig, Swiss Federal Laboratories, Switzerland
Mr. P. Ruch, Service Hydrologique, Switzerland
Mr. J. Benes, Cesky Ekologicky Ustav, Czech Republic
Mr. J. Santroch, Czech Hydrometeorological Inst., Czech Republic
Mrs. E.F. Karadag, Min. of the Env., Turkey
Mr. G. Tuncel, Middle East Technical University, Turkey
Mr. V.O. Demkin, Min. for Env. Protection, Ukraine

Questionnaires that have been sent: MA1-1, MA1-2, MA3-1

National Reference Centres

Mr. N. Heidam, Nat. Env. Research Institute, Denmark
Mr. H. Werner, Umweltbundesamt, Germany
Mr. D. Asimakopoulos, NOA, Greece
Mr. M. Mc Gettigan, Env. Prot. Agency, Ireland
Mr. R. Abbondanza, Min. dell' Ambiente, Italy
Mr. T. Weber, Administration de l' Environnement, Luxembourg
Mr. D. Onderdelinden, RIVM, The Netherlands
Mr. H. Dovland, NILU, Norway
Mr. P. de Pablo Ricote, MOPTMA, Spain

Questionnaires that have been sent: MA1-1, MA1-2, MA3-1

APIS users and suppliers

Mr. M. Rasse, I.H.E., Belgium
Mr. P. Hecq, CEC, Urban Environment/Air Quality, Belgium
Mr. P. Suhr, Env. Prot. Agency, Denmark
Mr. W. Wycisk, Umweltbundesamt, Germany
Mr. L. Viras, Min. de l'Env., Greece
Mr. G. Harrahill, Dept. of the Env., Ireland
Mr. L. Seller, Min. Ambiente, Italy
Mr. S. Solagna, Administration de l'Env., Luxembourg
Mr. S. Buitenkamp, Ministry of Env., The Netherlands
Mrs. B. Lübker, WHO-ECEH, The Netherlands
Mr. F. Boavida, Inst. de Meteorologia, Portugal
Mr. S. Jimenez, Direttore General de Politica Ambiente, Spain
Mr. L. Edwards, Dept. of the Env., United Kingdom

Questionnaires that have been sent: MA2-1

NB1: The list is arranged according to the alphabetical order of the countries, see behind names and affiliation (except for UN/ECE/WHO)

NB2: Questionnaire MA2-2 will be sent later

24 February 1995