European Topic Centre on Air Quality

AIR POLLUTION MONITORING IN EUROPE PROBLEMS AND TRENDS

By

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November 1996

This report was prepared under the supervision of G. Kielland, Project Manager,
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Cover Design: Folkmann Design and Promotion

Note

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Cataloguing data can be found at the end of this publication

Printed on recycled and chlorine-free bleached paper

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Acknowledgement

The following significant assistance in data collection and preparation of this report is acknowledged:

- The WHO Collaborating Centre for Air Quality Management and Air Pollution Control, at the Institute for Water, Soil and Air Hygiene (WABOLU) - Federal Environment Agency of Germany, Berlin, by Hans-Guido Mücke and Elisabeth Turowski, for providing their questionnaire as a model for our MA 1-2 questionnaire, and for providing data on the monitoring networks in 5 countries.

- The National Focal Points and the Reference Centres of the participating countries, and regional offices in some countries (e.g. Spain), that filled out the questionnaire and sent other information.

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Summary

This report presents an overview of the air quality monitoring practice in Europe in recent years. The summary is based on information in questionnaires sent out in 1994 and returned by 24 countries, and other information from national and technical reports for some of those countries and for 6 other countries. Information was received from a total of 30 European countries, all 15 EU Member States inclusive. No information was available from Belarus, Bosnia-Herzegovina, FYROM, Latvia, Lithuania, Malta, Moldova, the Russian Federation, Turkey, Ukraine, the Federal Republic of Yugoslavia.

Based upon monitoring requirements set in EU Directives, the "monitoring practice" is described in terms of coverage (compounds, spatial, temporal, site category), monitoring methods, data availability, data reporting and network/site description.

The information is presented at several levels of aggregation: countrywise network description tables (Appendix B), country summaries (Appendix A), European wide summary tables of monitoring practice (Chapter 3), a basis for the European scale summary description (Chapter 4).

It is acknowledged that the information collected is not complete in all respects for all countries. Only for some countries, comments to the first draft summaries were received (Austria, Denmark, Finland, Germany, Portugal, Sweden). The summaries are therefore presented with the reservation that the information may not be complete.

The coverage of air quality monitoring in Europe, in terms of time, space, compounds and site categories is substantial for most of the reporting countries. There are a total of close to 5,000 sites for urban/local monitoring and more than 750 sites for regional monitoring. Hot-spot sites (traffic, industry) is less well represented than are general urban background sites. In a number of countries, lead monitoring seems no longer to be well represented and in some countries ozone is not monitored. Ozone precursors are monitored at one or a few regional sites in 7 countries only.

From the information available for this report, the shortcomings or gaps in the coverage, in terms of complete mapping of areas of high concentrations and exceedances, cannot be judged in detail. Such an evaluation must be carried out by each state.

Table S1 gives the inventorized number of monitoring sites in each country, for various site categories of local and regional sites. Figures S.1 and S.2 shows total number of sites for local and regional monitoring in each country.

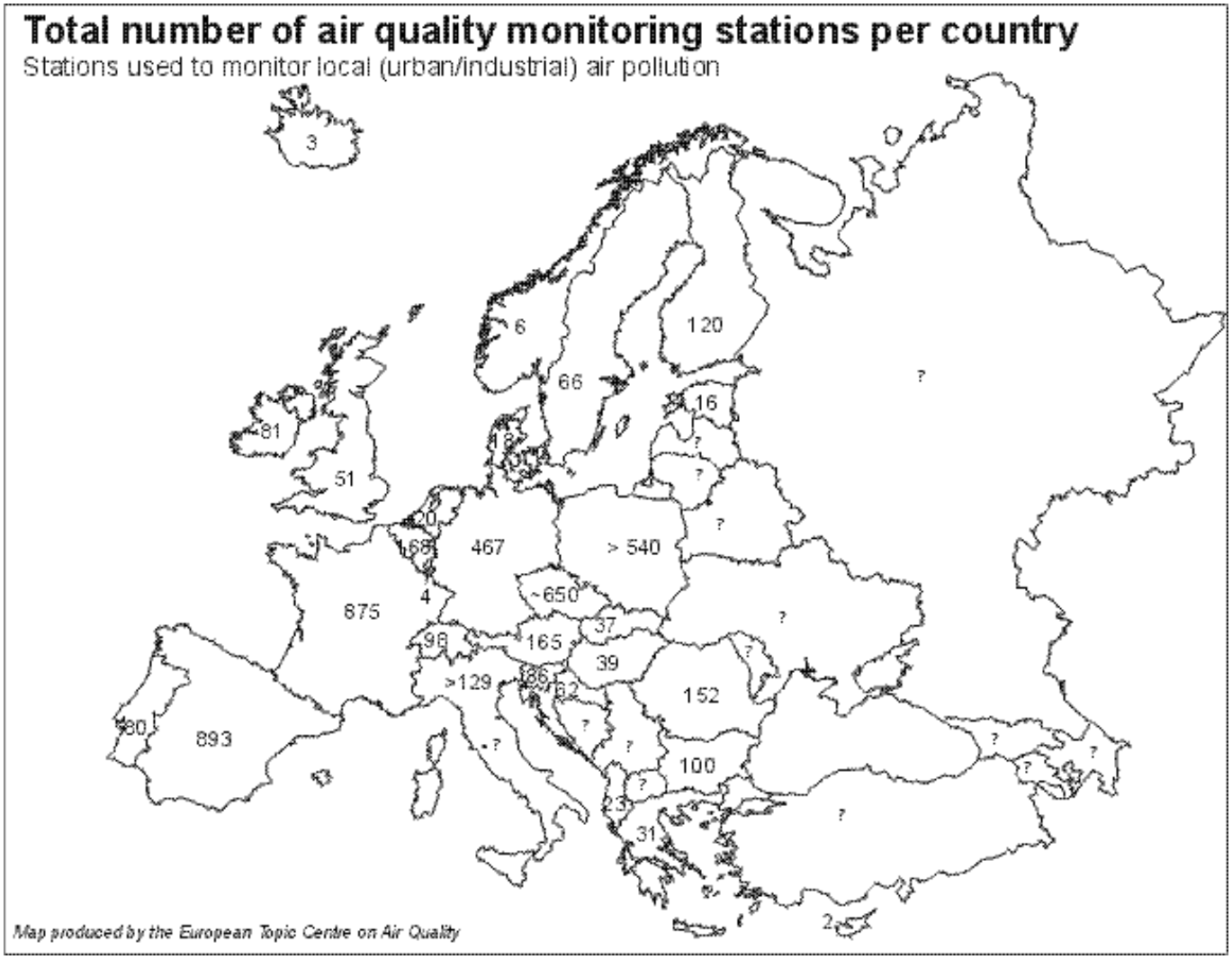
Table S.1: Spatial coverage, European AQ monitoring.

	LOCAL						REGIONAL			
	No. of sites	No. of cities/towns	Site class distribution				No. of sites	SO_2 +*	Dep.*	O_3*
			UG*	UT*	UI*	RI*				
Austria	165	10	100	30	20	15	55	55	35	55
Belgium	168	60	125		30	13	25			
Denmark	18	3	7	8	3	0	17	6	17	3
Finland	120	30	71	18	28	3	22	8	7	9
France	875		875				21	17		21
Germany	467		232	156	79		74	65[8)]		57[8)]
Greece	31	11	22	2	7	0	1	1	1	0
Ireland	81	15	45	25	10	1	12	7		5
Italy	129[3)]	41	129				3[4)]	3	3	2
Luxembourg	4	1	1	2	1	0	2	1	0	1
the Netherlands	20	9	7	13	0	0	36	30	14	26
Portugal	80	5	6	15	6	53	13	12	3	3
Spain	893		288	438	167		190			>7
Sweden	66	45	63	3			49	12	36	5
U.K.	51[5)]	34	45	2		4	>38	38	32	15
Iceland	3	2	1	1	0	1	1	1		
Liechtenstein	1	1	1	0	0	0				
Norway	6	6	6	0	0	0	39	12	34	15
Albania	23	11	23							
Bulgaria	100		100							
Croatia	62	8	62				1	1	0	0
Cyprus	2	1	0	2	0	0	1	1	1	1
Czech Republic	650[1)]									
Estonia	16	9	8	2	6		2	2	2	2
Hungary	39		39				2	2	2	
Poland	>540	[7)]	>500		33		11			
Romania	152		152				138	4	137[2]	4
Slovakia	37	17	14	6	10		7	7	7	4
Slovenia	86		86				4			
Switzerland	98[6)]		55	31	12		54			
TOTAL	>4983						>818			

UG - Urban general (in-city background) site
UT - Urban traffic site
UI - Urban industrial site
RI - Industrial site not in urban area

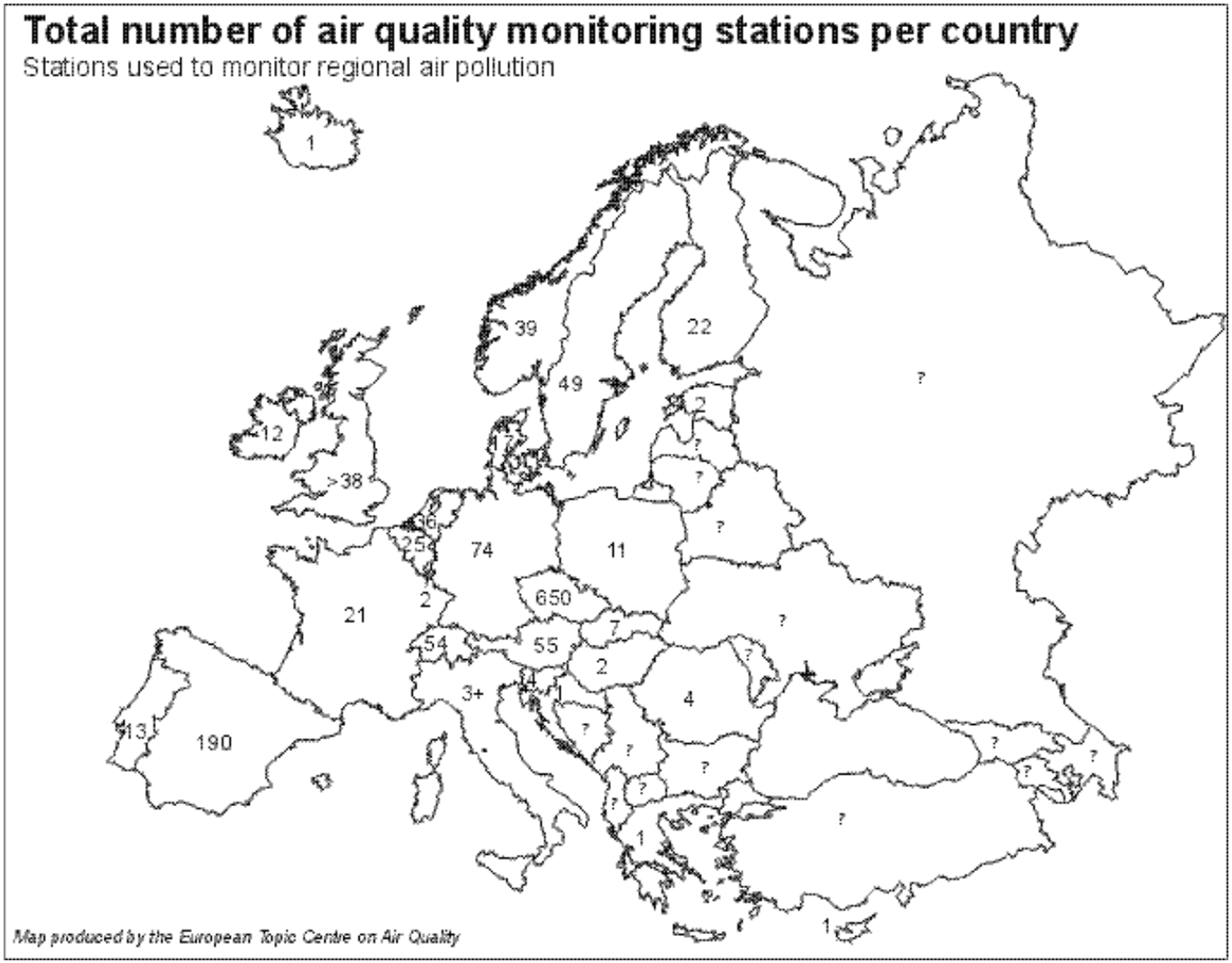
SO_2+ - S and N compounds in air (gases and aerosol)
Dep - Precipitation chemistry
O_3 - Ozone

1) Total for urban and regional. Site classification not known.
2) All stations measure pH, conductivity and acidity/alkalinity. 14 sites measure major ions.
3) Not complete.
4) Only EMEP sites
5) Plus 1100 passive NO_2 sampling sites
6) Plus 12 passive SO_2 and 102 passive NO_2 sites.
7) All cities with >20,000 inhabitants.
8) The number of sites may not be quite correct.



Czech Republic: The number gives the sum of local and regional monitoring sites.

Figure S.1: Number of sites per country for the monitoring of urban/local/industrial air pollution.



Czech Republic: Sum of local and regional sites. Romania: Stations with only precipitation chem. (137) not included in the number.

Figure S.2: Number of sites per country for the monitoring of regional air pollution (incl. wet deposition).

International monitoring networks are also inventorized: ECE-EMEP, OSPAR, HELCOM, MEDPOL, GEMS/AIR, GAW, TOR, AMAP. Table S2 gives an overview of number and types of sites in these networks. Many stations operate under many of these networks simultaneously.

Table S.2: Summary of recent monitoring activities in Europe in international programmes.
For all programmes: Not all compounds are measured at all sites.

Programme	Sites	Countries	Compounds (summary)
EMEP (1995)	126	28	S- and N-compounds in air (gases and particles) and precipitation, and O_3 and VOC in air.
OSPAR (1994)			
Precip.	25	10	Cd, Hg, NO_3, NH_4, (priority) As, Cr, Cu, Ni, Zn, organo-halogens (grey list)
Aerosol/gas	12	6	Cd, Hg, a-HCN, g-HCN, HNO_3, NO_3, NO_2, NO, NH_3, NH_4 (priority) As, Cr, Cu, Ni, Pb, Zn (grey list)
HELCOM	31	8	N compounds in air (gases and particles), and in precipitation. Metals (Pb, Cd, Cu, Zn) in airborne particles and in precipitation. Cr, Ni, As, Hg in precipitation.
MEDPOL	13	10	Emphasis on heavy metals in aerosol, and heavy metals and major ions in precipitation.
GAW	61	23	Precipitation chemistry.
	100	29	"Trace gases": O_3 (81), NO_x (43), SO_2 (34), CO_2 (20), CH_4 (7), N_2O (3), CFCs (4).
	42	19	Aerosols
	16	5	Radiation
	14	10	Turbidity
TOR (1994)	29		O_3, NO, NO_2, NO_y, CH_4, CO, NMHC, J_{NO2}, met.data.
AMAP	5*	5	Acid.dep., heavy metals, pesticides, PCBs, PAH
GEMS/AIR (1993/94)	9	9	SO_2, SPM

* Only one site, Ny Ålesund at Spitzbergen, in Europe.

As a rule, monitoring data are in most countries not readily available to external users, soon after monitoring. From the available information, Austria, Denmark, Germany, the Netherlands, U.K., Norway and Cyprus make data from monitors available to external users in near-real-time. This list is probably not complete. In Germany near-real-time data are published on videotext (television) and/or screentext (T-online) several times a day.

Most countries from which we have specific information on this topic, have validated data available in their own data bases within 6 months after measure-

ments. Thus, there should be no problem in principle in making the data available to the EEA within 6 months into the year after.

Reports containing data statistics, summaries, evaluations and assessments are available annually from most countries. Those reports present the air pollution data in various ways, and not always in accordance with the requirements of the EU Directives on parameters/statistics to be reported. This makes comparisons of air quality between countries in Europe problematic.

In many countries, the monitoring system is undergoing substantial modification (e.g. Austria) and extension (e.g. UK). There is a trend towards establishing national centres for on-line data collection (e.g. France, Norway).

Many countries reported the use of dispersion models as part of their air quality surveillance, e.g. Finland, the Netherlands, Norway, Sweden, UK. In Norway, the AirQUIS system being established in some cities provides the ability to model urban-scale air quality in near-real time.

1. Introduction

1.1 Goal and scope of the project

Project MA 1[1] of the Multiannual Work Programme 1994-1999 of the European Environment Agency entitled "**Air Quality, General Approach to Assessment**", consists of the following three sub projects:

MA 1-1 Collection of information on requirements for monitoring information.

MA 1-2 Report on the state of the (monitoring) situation - problems and trends.

MA 1-3 Report on recommendation for approach to be adopted at the European level.

The present report regards MA 1-2. The main goal of the report is to present a summary of the situation regarding air pollution monitoring in Europe, based on an inventory of **current monitoring practices**. This summary is the basis for the discussion in this report and in the MA 1-3 report on current problems (shortcomings, etc.) and current trends regarding monitoring.

The scope of the work can be summarised as follows:

- To inventorize current monitoring practices in EU Member States and other European countries, using the GIRAFE/APIS data base, reports and additional information from questionnaires.

- To inventorize current European scale air pollution networks (EMEP, WHO-GAW, WHO/UNEP-GEMS, OSPAR/HELCOM/MEDPOL) and research networks such as EUROTRAC and AMAP.

- To inventorize the availability of complementary information needed for assessment and regulation, such as emission data and modelling, and signal gaps.

The geographical coverage should be in principle pan-European. The report covers monitoring practices in EU member states, European Economic Area countries (Iceland, Norway, Liechtenstein) and other countries, with a boundary towards the east which follows the Ural mountain chain.

1.2 Information sources

The basic sources of data and information used in the work on this project includes:

[1] MA: Monitoring Air

- Returned questionnaires, sent out to all the countries during February 1995 (with a later reminder). The design of the questionnaire was partly based upon a similar questionnaire sent out previously by WABOLU in Berlin, the WHO collaborating centre for air quality management and air pollution control. A copy of the questionnaire is given in Appendix C.

  The questionnaire was returned by the following 20 countries: Cyprus, Czech Republic, Denmark, Finland, Germany, Greece, Hungary, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Romania, Russian Federation (the MA1-1 part), Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

  Some countries responded to the questionnaire by sending reports or data tables/diskettes. This was done by Austria, Estonia, France, Italy, Liechtenstein, Portugal.

- Copies of the WHO questionnaire were kindly made available to us by WABOLU for the following 5 countries: Albania, Belgium, Bulgaria, Poland, Slovenia.

  WABOLU in September 1995 published the results from its survey of air monitoring networks (Mücke and Turowski, 1995). The report contains information from the following 11 countries: Albania, Austria, Belgium, Bulgaria, Croatia, Czech Republic, Hungary, Norway, Poland, Slovenia, United Kingdom. For these countries, in addition to tables similar to those presented in Appendix B of this report, their report contain maps with locations of the monitoring sites.

  No specific information was available[2] from Belarus, Bosnia-Herzegovina, Former Yugoslavian Republic of Macedonia (FYROM), Latvia, Lithuania, Malta, Moldova, Russian Federation, Turkey, Ukraine and Federal Republic of Yugoslavia. These countries are not included in any of the summary tables.

- National reports on networks and air quality data obtained through the questionnaire procedure, during the Europe's Environment report work in 1992-93, and otherwise.

- The current APIS/GIRAFE data bases.

- Reports and overviews from the European monitoring networks (EMEP etc.)

- The MA1-1 report (van Aalst et al., 1995).

In Appendix D, the available sources of information are listed per country.

[2] Except for on EMEP stations, of which Latvia, Lithuania, Russian Federation, Turkey and Federal Republic of Yugoslavia has at least one.

For European-scale air pollution networks, information was found in annual and other reports from those networks, as listed in the reference list.

1.3 Methodology of inventorizing current monitoring practices

"Monitoring practices" is defined as the way air pollution monitoring is carried out in terms of compounds measured, methods used, site representativity, spatial and temporal coverage of stations and networks, availability of the data, and how data are reported.

To be able to report on "the state of the monitoring situation - problems and trends", it is advantageous to have a yardstick against which to evaluate the monitoring activities going on in each country, in the EU, and for Europe as a whole. Such a yardstick should be sufficiently comprehensive so that a monitoring programme which complies with the requirements will form a basis for:

- assessing and mapping the zones with unacceptable air quality
- evaluating the effects of the air pollution
- quantifying or estimating the contributions to the air pollution concentrations from the various source categories of the area, as a background for formulating Action Plans.

The air pollution Directives of the EU may be considered to form a "basic yardstick". On top of that, it is of interest to see what the bulk of European countries actually do in their monitoring networks, and use that as a "developed yardstick" for monitoring in Europe against which to evaluate each country. The requirements to monitoring and reporting which are set in the Directives, are described in Chapter 2.

With a view to the monitoring requirements as set in the Directives, ***monitoring practice*** is in this report defined according to the following items:

1.	Compound coverage	Does the network(s) cover all effects - relevant compounds in the area?
2.	Spatial coverage	Does the network(s) cover the areas of high and typical air pollution exposure of the population?

3.	Monitoring site category[3] coverage	Does the network(s) spatially cover the relevant site categories? - urban general (urban background) - traffic hot-spot - industrial hot-spot (urban/rural) - regional background/rural
4.	Temporal coverage	Does the network(s) cover all relevant periods of elevated and typical pollution levels?
5.	Methods evaluation	Are the methods used: - advanced - complying with EU standards or other requirements - non-standard?
6.	Data availability	Are the data available to users on-line (near real time) or otherwise?
7.	Reporting	Are the data and their statistics reported regularly (when) and in compliance with regulations?
8.	Network/site description	Is this available in a report?

Additional requirements to air pollution monitoring are set in some of the international conventions, notably the UN-ECE Convention on Long-range Transboundary Air Pollution and others, which are described in Chapter 2.

As described in the draft MA1-1 report, monitoring may serve several purposes and functions, listed as:

- Regulatory	:	Monitoring to fulfil legal or regulatory obligations
- Compliance	:	Monitoring to check compliance with goals formulated in conventions and other agreements
- Policy support	:	Monitoring to provide information/ assessments to support policy development
- Impact assessment	:	Monitoring as part of assessment of impacts (on health, materials, ecosystems)
- Public information and alert:		Monitoring as basis for factual “on-line” info to the public, and basis for warnings
- Scientific research	:	Monitoring to investigate processes and new scientific questions, verification of models, etc.

[3] Monitoring sites can be categorized in several ways. Here we use the scheme of category according to the a) type of area in which the site is located (here: urban, regional (or rural) and b) which source type in dominating or influencing the site (here: no specific source (urban background), traffic, industrial).

One of the questions of the questionnaire regarded the definition of the main purposes of each of the networks of the country. The function or purpose underlying the networks is also a part of the criteria against which the monitoring practice can be evaluated. This has been summarised in the MA 1-1 report (van Aalst et al., 1995).

1.4 The contents of this report

The information on air pollution monitoring networks is presented at several levels of condensation:

- The information in the questionnaire and the available national reports collected is used to produce **country-wise network summary tables (Appendix B)**. In these tables, the various networks are presented in terms of:

  - Network description : - Name
    - Level of network (national, regional, local)
    - Purpose/function
    - Representativity scale of sites (urban, hot-spot, regional)

  - Monitoring : - No. of sites of each category
    - Compounds
    - Temporal coverage
    - Methods/quality control

  - Data reporting : - Data availability
    - Report availability

- Based on the tables in Appendix B and additional information, **country summaries** (3-5 pages plus selected annexes) are presented in **Appendix A**. The country summaries contain the following items:

  1. National monitoring requirements
  2. Approach to air quality (AQ) monitoring and assessment
  3. Monitoring coverage
  4. Methods evaluation
  5. Data availability
  6. Reporting
  7. Application of monitoring results (purpose/function of monitoring)
  8. Near-future developments of networks.
  9. Responsible agencies

  The country summaries have been written by the Topic Centre team, except for the Portugal report, which was provided by the Portuguese responsible institution. Draft summaries were sent to the National Reference Centres for comments and completion, and detailed comments were received from some countries (Austria, Denmark, Finland, Germany, Portugal, Sweden). For some countries the information which was made available under this project is not

complete. Thus it is acknowledged that the country summaries for some of the countries do not present a complete picture of the AQ monitoring.

- The third level of condensation is covered in Chapter 3, which contains tables on local (urban and hot-spot) and regional air pollution monitoring respectively. In these tables, there is basically one line for each country. The columns of these tables conform with the 8 items listed in Section 1.3 defining “monitoring practice”.

- In Chapter 3 a short summary text description of the monitoring practice is then attempted for each country with a view to shortcomings as evaluated against the requirements of the EU Directives.

Finally, in Chapter 4 a summary is given of the monitoring situation on the European scale, its problems and trends, as stated in the terms of reference of the project.

2. Requirements to AQ monitoring in Europe

2.1 EU Legislation

Requirements to how monitoring and assessment of air pollution should be carried out is, for the member states of EU and associated countries, given in EU Directives and Decisions.

There are also national requirements to monitoring which may, or may not, agree fully with the EU requirements. The national requirements are, if available or formulated, described in the country summaries (Appendix A).

The Directives stating requirements on the air pollution monitoring and assessment, are (see Tables 2.1-2.3):

- The compound-specific directives: SO_2 and SPM, Pb, NO_2, O_3 (1980-95).
- The Exchange of Information (EoI) Decisions of 1976, 1982 and 1995.
- The draft Council Directive on ambient air quality assessment and management ("Framework Directive, FWD") of 1995.

The EoI Decision only sets reporting requirements, no monitoring requirements. The requirements are summarised in the following paragraphs. Tables 2.1 to 2.3 specifies the requirements further.

The present compound-specific Directives for SO_2, TSP/Black Smoke (BS), Pb, NO_2 and O_3, issued during the period 1989-95, require in principle that all exceedances of the limit values are detected, and thus require that a thorough assessment process should support the selected sites of the monitoring system.

The statistics to be reported, in addition to the exceedances, are mean, median, 98-percentile and maximum values (for either 1h or 24h basic sampling resolution) (and 99.9-percentile for 1h sampling resolution).

The data should be reported within 6 months of the next reporting year. (Calendar year for Pb, NO_2 and O_3; Tropical year (April to March) for SO_2, TSP, BS).

For ozone, the Directive requires that exceedances of alarm values are reported without delay to the public, and within 1 month to the Commission.

The present Draft Exchange of Information (EoI) Decision requires a similar extent of reporting, and specifies in addition:

- Detailed network and site description.

- Reporting of 31 compounds in addition to those of the compound-specific directives, to the extent that they are measured. The additional compounds include for instance CO, NO_x, acidity, VOC and specific organic compounds, heavy metals (7 of them), organic contents of particles.

- The data files, of specified format, should be delivered to the data base manager within 1 October of the next year.

The Draft Framework Directive on Ambient Air Quality (FWD) requires that the air quality is assessed relative to the limit values which are in effect at any time. The required reporting relative to the draft FWD is as follows:

- The member states shall provide annually a list of all areas of exceedance of limit values, within 9 months of the next year.

  The Commission shall annually publish the list referred to above. Information shall be given on the nature and origin (sources) of the pollution, and assessment techniques used, and also on the measures in place, or planned, to improve air quality to within acceptable limit values.

- The compounds are those for which EU limit values are given, plus additional compounds:

  * pollutants covered by directives : SO_2, NO_2 and NO_x, BS, SPM (PM_{10}), Pb, O_3

  * other pollutants for consideration : CO, Cd, Acid.dep., benzene, PAH(BaP), As, F, Ni.

The current monitoring practices, as summarised for each country in Appendix A, are evaluated in Chapter 3 relative to the EU requirements. The influence on the monitoring practices of the national requirements is taken into account.

Table 2.1: Requirements from compound-specific directives (CSD).

Compound	Coverage		Reporting	
	Spatial	Time	Parameters	Time schedule
SO_2, SPM (89/427/EEC)	In principle, full coverage, since all exceedances should be detected. • where there is exceedance • where prevention of further increase is necessary • in specially protected areas	Year round	24h average, median,98 percentile, annual average	6 months after reference year
Pb (82/884/EEC-(Lead)	As above	Year round	Annual average	6 months after new year
NO_2 (85/203/EEC-NO2)	As above	Year round	As for SO2, SPM	As above
O_3 (92/72/EEC) (Simultaneous measurements of NOx and VOC recommended)	• Selected sites of expected highest exposure • Additional sites, to provide info on O_3 formation	Year round	1 h, 8 h, 24 h: maximum, mean, 98 percentile, no., date, duration of exceedances	• Immediate info to the public • Report 6 months after new year

The CSD Directives also require reporting of the reasons for exceedances, and implemented policies to avoid reoccurrence ("Article 3 zones").

Table 2.2: Requirements from Draft EoI Decision (EU, The Council, no. 12122/2/95, Rev. 2).

The exchange of information concerns:

- networks and station descriptions
  - * geographic representativity
  - * local influences
  - * methods
  - * data logging, transfer, etc.
- measurement data and statistics.

Compounds to be reported

			No.
• Classic, 24 hour	:	SO_2, acidity (AF), SPM, PM_{10}, black smoke, Pb	6
• Classic, 1 hour	:	NO_x, NO_2, CO, O_3	4
• Inorganic gases, 24 hour	:	H_2S, CS_2, NH_3	3
• Metals, 24 hour	:	Hg, Cd, Ni, Cr, Mn, As	6
• Organic gaseous, 24 hour	:	VOC(T), VOC(NM), benzene, toluene, styrene, butadiene 1,3	6
		formaldehyde, PAN, CH_2-CH-CN, C_2HCl_3, C_2Cl_4, CH_2Cl_2, VC	7
• Organic particles, 24 hour	:	BaP, PAH	2
• Wet deposition, 1 month	:	N- and S-deposition, acid dep.	3
Total			37

Sites to be reported

- All sites established under the compound-specific Directives.
- Additional sites, selected by member states, for additional compounds.
- Sites operated under the 1982 EoI Directive.

Statistics

- Concentrations in air : average, median, 98%ile (99.9%ile for 1-hour values), maximum
- For ozone : as above, but statistics for 8-hour values in addition (99.9%ile not required)
- Deposition : monthly averages.

Reporting timeframe

Data files should be transferred to the Commission before October 1 the year after the reference year.

Table 2.3: Requirements to monitoring and reporting from the Draft Framework Directive (FWD) (Council Directive 95/9514/EC).

Air Quality Assessment

The FWD requires that Air Quality Limit Values (AQLV) are set. Once they are set, the air quality in member states should be assessed as follows:

- Measurement is mandatory
  - in agglomerations with more than 250,000 inhabitants (or population density >xxx inhabitants per km^2. xxx to be decided by the member states).
  - in zones with conc. >x % of AQLV. (x to be determined).
  - in other zones with conc. >AQLV.
- If levels are < x% of the limit values, combined measurement and modelling may be used.
- If levels are < y% of the limit values, techniques of modelling or objective estimation might be used alone. (y to be determined).

"Assessment" is here understood as involving full description of the air quality, i.e. spatial coverage to detect exceedances.

Reporting

Members states shall provide

- annually a list of areas with AQ exceeding AQLV, within 9 months of a calendar year.

The Commission shall publish

- annually, the list of areas referred to above
- a report on air quality in the EU, every 3. year.

Compounds

1. Pollutants covered by EU Directives : SO_2, NO (and NO_x), BS, SPM (PM_{10}), Pb, O_3
2. Other pollutants of consideration : CO, Cd, benzene, PAH(BaP), As, Ni, Hg

Information to be reported on Action Plans

- Localisation of exceedances
- General information of those areas
- Responsible authority
- Nature and assessment of pollution
  - * previous concentration trends
  - * assessment techniques
- Origin of the pollutants (sources)
- Analysis of the situation
  - * factors responsible for excess
  - * details of possible measures
- Details of previous measures (before FWD)
- Details of present measures (after FWD)
- Details of planned measures
- References to information, data, and reports.

2.2 International conventions and monitoring programmes

2.2.1 ECE-EMEP

The main objective of the EMEP programme is to provide information on the transport and deposition of pollutants on the European scale. This is accomplished through the combination of monitoring and modelling. The transboundary fluxes are to be determined by model calculations. The monitoring network is to provide data for model control. The purpose of the EMEP monitoring network is to (ECE, 1994):

- provide information on the spatial distribution of air pollutants over Europe,
- provide a basis for comparison with model calculations,
- provide a basis for evaluation of time trends.

Following is a listing of the major recommendations concerning the EMEP monitoring programme (EMEP, 1995; EMEP, 1996):

Compounds/averaging time

Precipitation : SO_4, NO_3, NH_4, Ca, pH (H^+) (all 24 h)

Air : SO_2 (24h), SO_4 (24h), NO_2 (24h), O_3 (1h)
VOC (10 min. for light HC, 8 h for aldehydes and ketones)

Inclusion of heavy metals and POPs is considered. It is considered to allow precipitation sampling to extend for up to 7 days (weekly samples).

Spatial coverage

Assumed adequate coverage :	Central parts of Europe	:	150-200 km between sites
	Other areas	:	300 km or more between sites

This spatial density is considered adequate to provide a basis for comparison with models, but not necessarily sufficient to cover more local gradients.

Site location

The quality of the site location is considered very important. The site must be chosen so that samples are representative of the region of interest, and not unique to that particular site.

Quality of measurements

Quality control of the measurements is strongly emphasised in the programme. A long-term goal is a combined sampling and analysis uncertainty of 15-25%, depending upon component.

Temporal coverage and resolution

The programme recommends year-round operation. A 90% data completeness is considered a realistic objective.

It is under consideration to limit O_3 measurements to the summer half year (April 1-September 30).

2.2.2 Other European Conventions

These comprise the regional marine conventions in Europe, which are:

- The Convention for the Protection of the Marine Environment of the North-East 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, MEDPOL, under the UNEP Regional Seas Programme).

The monitoring programmes under these conventions focus on the marine environments, but also cover atmospheric input to the waters. Thus, both concentrations in air, and deposition of relevant compounds are covered by the monitoring programmes. Nutrients (N-compounds), heavy metals and persistent organic pollutants are covered, as well as ozone to some extent. The monitoring programs are described in Chapter 3.3.2.

OSPAR

The comprehensive atmospheric monitoring programme (CAMP) of OSPAR, established in 1980, is joined by the following countries, which report measurements from coastal stations:

Belgium, Denmark, France, Germany, Iceland, Ireland, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom.

The monitoring requirements were established in at the beginning of the 1980's and revised during the Third International Conference on the Protection of the North Sea, held in March 1990.

With respect to atmospheric inputs to the North Sea, The Hague Declaration adopted the following measures, which in effect also set the monitoring requirements:

1. For an agreed group of 17 substances, North Sea states should seek a reduction of 50% in atmospheric emissions by 1995, or by 1999 at the latest, provided that the application of Best Available Technology, including the use of strict emission standards, enables the reduction, and

2. For substances that cause a major threat to the marine environment, and at least for dioxins, mercury, cadmium and lead, to achieve reductions between 1985 and 1995 of total inputs (via all pathways) of the order of 70% or more provided that the use of Best Available Technology or other low waste technology measures enable such reductions.

HELCOM

The HELCOM Convention came into force in 1980, and was revised in 1992. The nine Baltic states, Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, the Russian Federation and Sweden participate as signatories, as does the European Union. Belarus, the Czech Republic, Norway and Slovakia also participate in the work.

Most of the decisions of the Commission are made as recommendations for implementation by the contracting parties through their national legislation. Regarding monitoring and evaluation of the effects of the pollution, there is a recommendation to "Monitor(ing) the marine environment, airborne pollution and radioactive substances".

MEDPOL

The Long-term Programme for Pollution Monitoring and Research in the Mediterranean Sea (MEDPOL-II) was launched in 1981 within the framework of the Mediterranean Action Plan (MAP) adopted by the governments in the region, in Barcelona in 1975. The MEDPOL airborne pollution monitoring and modelling programme was prepared in 1987, with WHO and UNEP as lead agencies.

The MEDPOL monitoring program is joined by France, Italy, Croatia, Greece, Spain, Cyprus, Turkey, former Yugoslavia, Morocco and Israel.

2.2.3 Other international monitoring programmes

Global Air Quality Monitoring System (GEMS/AIR) of WHO

The GEMS/AIR Programme is a global programme for urban air quality management. Since 1975 the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) have jointly operated the programme as a component of the United Nations Environment Monitoring System (GEMS). This again is a component of the UN Earthwatch System. During the 20 years of operation, the programme has developed activities in a number of areas, including

- support for the establishment of a global network of over 250 monitoring sites in about 80 cities in 40 countries.
- support of monitoring and assessment operations through training, expert advice, and logistical support.
- support of quality assurance procedures through collaborative reviews of city monitoring networks.
- development and publication of methodology handbooks.
- publication of air quality trends in selected cities around the world.

Since the beginning GEMS/AIR has sought to facilitate the monitoring and awareness of urban air quality particularly in developing countries.

In the participating countries, it was recommended to operate at least 3 stations located in city centre, in areas representative for commercial, industrial, residential areas respectively.

The GEMS/AIR network in Europe has through the last couple of decades consisted of up to 22 cities in 20 countries. The network is at present being reactivated after a period of very little reporting activity. For 1993 and/or 1994, only 9 countries/cities have reported data to the GEMS/AIR data base.

Global Atmospheric Watch (GAW) program of WMO

GAW was established in 1989 as an integration of the Global Ozone Observing System (GO_3OS, established in the 1950s) and the Background Air Pollution Monitoring Network (BAPMoN, established in the 1960s).

The network consists of two categories of stations: global (baseline) and regional stations. Participation in the GAW network is voluntary. Baseline stations are considered as research centres with a very extensive monitoring program, while regional stations have a more flexible, less intensive programme. (The monitoring programme is described in Chapter 3.3.2.)

EUROTRAC Tropospheric Ozone Research (TOR)

The EUROTRAC programme (a joint European project with the main aim to study the impact of human activities on the troposphere over Europe) was established in 1983, and includes 3 subprojects doing field measurements:

- ALPTRAC : High Alpine Aerosol and Snow Chemistry Study.
- TOR : Tropospheric Ozone Research.
- TRACT : Transport of Pollutant over Complex Terrain.

Of these, TOR has a substantial, long-term monitoring program covering most of Europe.

EUROTRAC is a scientific research programme with voluntary participation from research institutes, universities and industry. Participants come from the following 24 countries: Austria, Belgium, Bulgaria, Croatia, Denmark, Germany, Finland, France, Greece, Hungary, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the EC.

The TOR scientific objectives are to ascertain the increase of ozone in Europe over northern mid-latitudes generally, to determine and model ozone trends, and to try to measure transfer of ozone into the free troposphere.

The monitoring program is describe in Chapter 3.3.2. It includes, in addition to ozone, oxides of nitrogen, CH_4, CO, NMHC and meteorological data.

Arctic Monitoring and Assessment Program (AMAP)

The Arctic Monitoring and Assessment Program (AMAP) was established at the beginning of the 1990's between the following parties: Sweden, Norway, Denmark, Iceland, Finland, the Russian Federation, Canada, and the United States.

The main goal for AMAP is to present the assessment of the Arctic environment contamination by acidic compounds, heavy metals, POPs, radionuclides, as well as to provide information on components contributing to global change of the environment. The assessment includes sources, fluxes, pathways, environmental levels, and environmental and health effects of the above mentioned groups of pollutants in the Arctic.

The program is now in its first phase, during which the assessment of problems have been the main emphasis. Planning of Phase 2 starts early 1997, during which the monitoring activities will be more important.

2.3 National requirements

National requirements to air quality monitoring are described for each country in the country summary texts in Appendix A, to the extent they are available.

For most countries, the national requirements are restricted "to check compliance with national and (for EU member states) EU Limit and Guide Values".

Examples of extended national requirements: In Austria the ozone law regulates the near-real-time information of the public about the ozone pollution situation throughout the country. In Slovakia the national requirements state specifically the responsibility to "inform the public" about the pollution situation.

3. Summary of monitoring practices in Europe

3.1 Summary on European scale of country-wise monitoring programmes

Based upon the national summaries in Appendix A and the network/site information in Appendix B, a summary is presented here on the monitoring practices in each country.

The summarised description/evaluation of the monitoring practices in each country is given in Table 3.2. and Table 3.3, for local and regional monitoring respectively.

Blank space in the tables reflect that specific data on the item was not available to the Topic centre.

The information in these tables is very brief. It is intended to provide the itemised, condensed information necessary to enable an overall summary evaluation to be made of the current monitoring practices, and to be evaluated against EU and national requirements.

An explanation of the codes in the tables is given in Table 3.1.

Countries are categorised as EU member states, countries of the European Economic Area (Iceland, Liechtenstein, Norway), and other countries. Within each category, the countries are listed alphabetically.

Tables 3.2 and 3.3 enables a European overview of the monitoring situation. To expand somewhat on the information, a condensed description for each country is given in the text following the tables (Section 3.2).

The summary tables show that the information available is fairly complete for many countries regarding monitoring coverage and methods. However, as far as data availability, reporting and site descriptions is concerned, the information which was available to the Topic Centre is lacking for most countries, making a full evaluation of the state on the European scale incomplete.

The state of the monitoring situation in Europe is evaluated in Chapter 4.

Table 3.1: Explanation of codes in Tables 3.2 and 3.3.

Compound group codes[1]	:	**Urban**
		CSD[2] : Compounds of the EU Compound-Specific Directives
		FWD[3] : Framework Directive additions
		EoI[3] : Exchange of Information Directive additions
		Regional
		SO_2 + : S and N compounds in air, include. major ions in SPM, Black smoke
		Dep. : Deposition of S and N
		O_3 : O_3
		O_3-pre.: NO_x, VOC (O_3 precursors)
Spatial coverage :	:	Urban/local : No. of cities/No. of non-urban hot-spot areas
		Regional : No. of sites
Site category coverage	:	Urban/Local: UG : Urban general
		UT : Urban traffic hot spot
		UI : Urban industrial hot spot
		RI : Rural industrial hot spot
		Regional: SO_2 + : S and N in air, and Black smoke
		Dep. : Deposition, acid
		O_3 : Ozone
		O_3 pre : Ozone pre cursors (NO_x, VOC)
		The tables give number of sites in each category.
Temporal coverage	:	Year round
	:	Other
Methods evaluation	:	1. Advanced
	:	2. According to directives or equivalent
	:	3. Non-standard
Data availability	:	**Non-validated data in near real time**
	:	nrt-a: Near real time (1h data) in central database, accessible[4])
		nrt-na: Near real time (1h data) in central database, not accessible
		Validated data
		x-a: Available on data-file, accessible on electronic medium, after (x) months
		x-na: Available on data file, not accessible on electronic medium, after (x) months.
Reporting	:	O_3 : Smog information available to the public
		Other : After (x) months after calendar year
Network/site description	:	Available
	:	Not available

1 To categorise the compounds in **Urban** monitoring, codes are used which refer to the compounds which are listed in the various directives and EoI decision (CSD, FWD, EoI).
For **Regional** monitoring, it is instead referred to the following monitoring categories: S and N compounds and BS in air (called SO_2^+), S and N compounds in deposition (called Dep), ozone (O_3) and ozone precursors (O_3-pre).

2 x in the tables means that all CSD components are covered.

3 In the tables are listed the compounds which are monitored.

4 Accessible: means accessible through data-lines to (selected) external users.

*Table 3.2: Summary of monitoring practices, **local** air pollution (urban, traffic, industrial).*
(Codes/explanation to table: See table on page 27). (Open space means info not available).

EU Member states	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds			Spatial		Site category	Temporal						
	CSD	FWD	EoI	No. of cities	No. of non-urban hot-spots	UG/UT/UI/RI			Non-validated 1h data	Validated data 1 h/24 h	O_3	Other	
Austria	X	CO	VOC H_2S	10	15	100/30 /20 /15	Year round	2	nrt-a	1-a	Daily or several times a day	1	Available
Belgium	X	CO	VOC	60	13 (ind.)	125[3]/30/13	Year round	2					
Denmark	X[4]	CO Metals		3	0	7 / 8 / 3 / 0	Year round	2	nrt-a			Annually	
Finland	X	CO		30	3	71 / 18 / 28/ 3	Year round	1, 2				4	
France	X	CO	VOC			~875[2]	Year round	2			"Annually"		
Germany	X	CO Metals	VOC			232/156/79[5]	Year round	2			Monthly Annually		
Greece	X[4]	CO		11	0	22 / 2 / 7 / 0	Year round	2		1-2 - /		4-5	
Ireland	X			15		45 / 25 / 10 / 1	Year round	2[1]					
Italy[6]	X	CO		41[7]		129[8]							
Luxembourg	X	CO Metals	VOC	1	0	1 / 2 / 1 / 0	Year round	2		2 - /		2	

1) SO_2 : Total acidity
2) Urban (G + T + I)
3) UG + UT
4) Except Pb.
5) Urban Industrial + Rural Industrial
6) The available info. from Italy was not complete enough to allow a full summary to be made here.
7) Incl. industrial areas
8) total no. of sites included

Table 3.2 (contd.) (Codes/explanation to table: See table 3.1 on page 27).

EU member states	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds			Spatial		Site category	Temporal						
	CSD	FWD	EoI	No. of cities	No. of non-urban hot-spots	UG/UT/UI/RI			Non-validated 1h data	Validated data 1 h/24 h	O_3	Other	
the Netherlands	X	CO Metals	PAH	9	0	7 / 13 / 0 / 0	Year round	2	nrt-a	1.5-a/3-a	Every hour[2)]	6	Available
Portugal	X	CO	Acid.	5	3 ind. areas	6/15/6/53	Year round	2					
Spain	X	CO Metals	VOC H_2S			288/438/167[1)]	Year round	2					Available
Sweden	X	BTX	VOC	45		63 / 3 /	6 winter months except: O_3 and 21 NO_2 sites: only summer	1, 2, 3		"as soon as possible"	"Annually"		
U.K.	X	CO Metals	PAH VOC	34	4 (ind.)	45 / 2 / / 4 NO_2 passive: 580/260/260/0	Year round	2	nrt-a	SO_2 :3 - a Acid: 3-6 - a	Twice a day	"Annual"	

1) UI + RI 2) In summer, by public broadcast. The same procedure for SO_2 in winter.

Table 3.2 (contd.): (Codes/explanation to table: See table 3.1 on page 27).

Countries of the European Economic Area	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds			Spatial		Site category	Temporal						
	CSD	FWD	EoI	No. of cities	No. of non-urban hot-spots	UG/UT/UI/RI			Non-validated 1h data	Validated data 1 h/24 h	O_3	Other	
Iceland	SO_2, NO_2, O_3	CO, PM_{10}		2	1	1 / 1 / 0 / 1	Year round	2					
Liechtenstein	SO_2, NO_2, O_3, TSP	CO		1	0	1 /	Year round	2			Included in Swiss report		
Norway	NO_2 O_3	PM_{10}	VOC	6	0	6 / 0 / 0 / 0	Winter 6 months	1,2	nrt-a	1- a/2- a			
Other countries													
Albania	SO_2, NO_2, O_3, TSP			11	0	23[1)]	Year round[2)]	3					
Bulgaria	SO_2, NO_2, Pb, TSP	CO, As	H_2S			100[3)]	Year round	2, 3					
Croatia	SO_2, NO_2, BS, TSP		H_2S PAH	8		62[4)]	Year round	2, 3					
Cyprus	X[5)]	CO		1	0	0 / 2 / 0 / 0	Year round	2	nrt-a	2-a		12	
Czech Republic	X	Metals PM_{10}		6)		650[6)]	Year round	2					
Estonia	SO_2, NO_2, O_3, TSP	CO BTX	H_2S	9		8 / 2 / 6		2, 3					
Hungary	SO_2, NO_2, O_3, TSP	CO	VOC			39[7)]	Year round			3	12		
Poland	X	CO	VOC Metals	8)		>500[9)]/33 (RI)	Year round	2					
Romania	SO_2, NO_2, O_3	CO	VOC			152[10)]		2, 3	11)	1-2	6-12		

For remarks, see next page.

1) One stationary and one mobile site in each city. Not known how many urban background or hot-spot sites.

2) 7-10 days per month.

3) Covering large towns, industrial hot-spots, health resorts.

4) Covering towns and industrial basins.

5) Including PM_{10}.

6) Total no. of sites: ~650 (urban + rural). The automatic network has 37 urban sites and 37 rural/regional sites. The impression is that the networks cover all major polluted areas, including industrial hot-spots. The extent of monitoring at traffic hot-spots is not clear.

7) 8 sites in Budapest. Number of cities, and site classification, is unknown.

8) All cities with more than 20,000 inhabitants. In addition, at least 8 local networks around local industries, with 33 sites.

9) Incl. possible traffic hot-spots sites.

10) Sites in local networks, incl. cities, towns and industrial areas. 25 sites in Bucuresti.

11) Daily information to public through mass media may be given.

Table 3.2 (contd.) (Codes/explanation to table: See table3.1 on page 27).

Other countries	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds			Spatial		Site category	Temporal						
	CSD	FWD	EoI	No. of cities	No. of non-urban hot-spots	UG/UT/UI/RI			Non-validated 1h data	Validated data 1 h/24 h	O_3	Other	
Slovakia	X	CO		17	7	14 / 6 / 10 /	Year round	2	na	1-a /		8	
Slovenia	X	CO				86[1)]	Year round	2	2)			4-5	Available
Switzerland	SO_2, NO_2, O_3, TSP	CO	VOC			55 / 31 / 12 / [3)]	Year round	2				7-8	

1) The classification of the sites is not given.
2) Daily data are available to the public from the 8 sites in the ANAS system.
3) 12 passive SO_2 , 102 passive NO_2 and 41 dustfall sites come in addition.

*Table 3.3: Summary of monitoring practices, **regional** air pollution. (Codes/explanation to table: See table3.1 on page 23).*

EU Member states	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds				Spatial	Site category	Temporal						
	SO_2+	Dep.	O_3	O_3 -pre	No. of sites	SO_2+/ Dep. / O_3			Non-validated 1h data	Validated data 1h/24 h	O_3	Other	
Austria	X	X	X	X	~55	55 / 35 / 55	Year round	2	nrt-a	1-a	Daily or several times a day	1	Available
Belgium	X				25		Year round	2					
Denmark	X	X	X		17	6 / 17 / 3	Year round	2	Daily			Annually	
Finland	X	X	X		22	8 / 7 / 9	"	2		9 - ?		11	
France	X	X	X	X	28	17 / / 21	"	2					
Germany	X	X	X	X	74	65(?) / / 57(?)	Year round	2		AQ: 1-2 -a Precip.:>6 -a			
Greece	X	X			1	1 / 1 / 0	Year round	2		1-2 -		4-5	
Ireland	X		X		12	7 / / 5	Year round	2[1)]					
Italy[5)]	X	X	X	X	3	3 / 3 / 2	Year round	2		[6)]			
Luxembourg	X		X	X	2	1 / 0 / 1	Year round	2		2 - ?		2	
the Netherlands	X	X	X	X	36	30 / 14 / 26	Year round	2	nrt-a	1.5-a/3-a	Every hour	6	Available
Portugal	X[2)]	X	X		13	12 / 3 / 3	Year round	2					
Spain	X	X	X	X	7[3)] 187[4)]	7 / 7 / 7	Year round	2					Available
Sweden	X	X	X	X	49	12 / 36 / 5	Year round	2		"as soon as possible"			
U.K.	X	X	X	X	>38	38 / 32 / 15	Year round	2	nrt-a	SO_2 :3 -a Acid: 3-6 - a	Twice a day	Annually	

1) SO_2 : Total acidity
2) Only SO_2 and SO_4
3) National network
4) Total number of "regional" sites
5) The available info from Italy was not complete enough to allow a summary to be made here. This summary only includes the 3 EMEP stations. There may be several more regional rural sites in Italy.
6) Data is available at EMEP-CCC monthly from Ispra, and with a delay of 6-12 months from the other 2 sites.

Table 3.3 (contd.) (Codes/explanation to table: See table 3.1 on page 27).

Countries of the European Economic Area	Coverage							Methods evaluation	Data availability		Reporting		Network description
	Compounds				Spatial	Site category	Temporal						
	SO_2+	Dep.	O_3	O_3 -pre.	No. of sites	SO_2+ /Dep./O_3			Non-validated 1h data	Validated data 1h/24 + h	O_3	Other	
Iceland	X	X			1	1 / 1 / 0	Year round	2					
Liechtenstein													
Norway	X	X	X		39	12 / 34 / 15	Year round	2	O_3 : nrt-a Other:2-na	6-8 - a		10-12	
Other countries													
Albania													
Bulgaria													
Croatia	X	X			1	1 /	Year round	2, 3					
Cyprus	X	X	X		1	1 / 1 / 1	Year round	2	nrt-a	2-a			
Czech Republic	X	X	X		Total no. of sites (urban+reg.) ~650 2 EMEP sites		Year round						
Estonia	X	X	X		2	2 / 2 / 2		2					
Hungary	X	X			2	2 / 2 /	Year round						
Poland					11[1)]		Year round	2					
Romania	SO_2, NO_2	X	X		5 (133 for precip.)	4 / 133 / 4		2,3				6-12	
Slovakia	X	X	X		7	7 / 7 / 4	Year round	2		2-3		8	
Slovenia	X	X	?		4[2)]			2					Available
Switzerland	X	X	X	X	54		Year round	2				7-8	

1) 6 GEMS, 4 EMEP, 1 HELCOM
2) 3 EMEP and 1 GAW site.

3.2 Country-wise brief summaries

The network and coverage (compounds, spatial, temporal) in each country are briefly summarised in this chapter. Also, shortcomings/gaps (when obvious from the collected information, when it is considered complete) and near-future trends (when information is given) are described.

Only a general summary regarding methods evaluation, data availability and reporting and network description is given immediately below.

Methods evaluation: Standard, generally accepted methods, samplers and monitors are used almost exclusively in most networks. These are methods as described e.g. in EU directives, or equivalent. Some countries in eastern Europe (Albania, Bulgaria, Croatia, Estonia, Romania) use to some extent non-standard methods which are not necessary equivalent to methods as described in the directives. Some countries uses advanced methods routinely at some sites, such as DOAS in Finland, Norway and Sweden, and on-line compound-specific VOC analysis in the UK.

Specific information on QA/QC procedures were in general not made available as part of this project.

Data availability: Specific information is missing for many countries, as shown in the Tables 3.2 and 3.3. Non-validated monitor data is, to our knowledge, available at a central data base for one or more networks in the following countries: Austria, Denmark, the Netherlands, UK, Norway, Cyprus.

Validated data are in general available after 1-3 months after measurement, but some countries need longer time, especially for data from manual samplers and for precipitation data.

U.K. has recently made the data from the automatic monitor programme available on-line on Internet. The preliminary data are updated with quality controlled data regularly, after a delay of 2-3 months.

Reporting: The time delay before reports are available varies substantially. Ozone represents a special case. For EU countries, the ozone directive requires that ozone is reported in principle to the public every day.

For local air quality, annual reports are available 4-12 months after the year, depending upon country (see Table 3.2). Some countries or networks issue monthly reports after a much shorter time delay. The reports are written in the national language, but some countries issue summary reports in English as well (e.g. Czech Republic, Slovakia, Slovenia).

Network description: Detailed site description is an important background for evaluating representativity of networks and for judging the air quality information from the network correctly. Dedicated reports with detailed site descriptions were available to us from Austria, the Netherlands and Spain. For some other countries,

brief descriptions were available within the AQ reports, such as for Sweden, the UK.

EU MEMBER STATES

Austria

The information available to us on air quality monitoring networks is fairly complete.

9 provincial networks are operated, mainly in urban/hot-spot locations, a total of 237 sites. All site categories are well covered. Most cities and larger towns (10) are covered. The national UBA network operates 8 regional sites. In addition, some local industrial networks exist. There is a smog warning system operated in the Vienna, Linz and Graz areas. A large part of the sites are equipped with monitors.

Coverage : Substantial spatial coverage, with e.g. 135 O_3 sites and about 150-200 sites for SO_2, NO_x, SPM. Acid deposition at 3 (EMEP) sites. CSD compounds (except Pb) and CO are well covered. VOC and H_2S is measured at some sites.

Reporting : For urban/hot spot networks : Province-wise. Available after 3 weeks of new year

For regional UBA sites : National report. Available after 1 month of new year

Trends : In the course of setting up a monitoring concept for the future Air Quality Protection Act, a review of the currently run monitoring networks is performed that will result in a reduction of monitoring sites for CO, and to a minor extent of SO_2, NO_2 and SPM, and a relocation of several sites in order to achieve a more homogenous spatial coverage; additionally a monitoring network for lead and benzene is being built up.

Belgium

The only information available to us on air quality monitoring networks was from the WHO questionnaire. It is not complete.

There are 3 networks in operation (“automatic”, sulphur-smoke, heavy metal), covering all 3 states (Brussels, Flanders, Wallonia). The networks have both urban, hot-spot and regional sites. There are a total of 193 sites. The networks cover 60 cities/towns and 13 industrial areas. Most sites are equipped with monitors. All site categories are well covered.

Coverage : Substantial spatial coverage for SO_2 and TSP (155/108 sites), and 23 NO_2 sites and 10 O_3 sites. CSD compounds

well covered. VOC and CO is measured at some (local) sites.

Denmark

Available information is fairly complete, through returned MA1-2 questionnaire, and annual reports.

There are 3 networks in operation (National Urban Area Program (LMP), Copenhagen network, Background network). There are 18 urban/hot-spot sites in 3 cities and 17 background sites (5 EMEP). All site classes are represented. Most sites are equipped with monitors for gases, and manual samplers for SPM.

Coverage	:	Spatially, the coverage may be complete enough to cover all areas with air quality problems. There are 6 regional SO_2 sites and 3 regional O_3 monitoring sites.
Data availability	:	Monitor data are available in near real time, from NERI.
Reporting	:	Annual reports are available after 10 months in new year.

Finland

Available information is rather complete through a completely filled-out MA1-2 questionnaire, and additional reports.

A regional network with 22 sites is divided into 6 subprogrammes (National, special, EGAP, EMEP, GAW, IM). The urban air quality monitoring system consists of 31 local networks (2 of them are private industrial networks), and consists of 117 sites in 30 cities/areas. Most sites have monitors for gases, and manual samplers for SPM.

Coverage	:	Substantial. There are 6 SO_2 background sites and 7 O_3 background sites.
Data availability	:	Quality controlled data are available after 9 months (background data) and 1 month (Helsinki network).
Reporting	:	Background network : After 11 months in new year. Helsinki network : After 4 months in new year.

France

Available info on monitoring networks is fairly complete through an annual AQ data report copy (1992/93) from ADEME. Specific info on methods and data availability is lacking.

The French AQ monitoring system consists of 29 regional networks, and some local, private industrial pollution networks. The regional networks are now linked to the Environmental Agency (ADEME) in Paris. There are a total of about 900 sites in operation, among them (approximate numbers) 380 for SO_2, 235 for NO_x, 107 for O_3, 68 for VOC, 86 for CO and 93 for SPM. About 95% of the total no. of sites are urban town/hot-spot sites, the rest are regional. Most sites are equipped with monitors for gases. 7 EMEP sites.

Coverage	:	Substantial. There are 21 regional O_3 sites, and 4 O_3 precursor sites.
Data availability	:	Near-real-time, for stations coupled to the ADEME network.
Reporting	:	Annual report covering all networks available 6-12 months after new year.
Trends	:	After all regional networks have been connected to ADEME, data will be available in near-real-time.

Germany

Available info on networks is fairly complete through a returned MA 1-2 questionnaire, a report "Guide to Air Pollution Monitoring Networks in EU (1990), German States", and annual reports from the "Länder".

There are 16 Federal State networks in Germany, with a total of about 550 sites, both urban, hot-spot and regional. A Federal (UBA) network runs 31 rural/regional sites, of which 17 are EMEP sites. At most sites, gases are measured with monitors, and SPM with automatic and/or manual samplers.

Coverage	:	Substantial.
Data availability	:	Quality controlled air data from UBA network and other networks are available 1-2 months after sampling, and precipitation data 6 months after sampling.
Reporting	:	Monthly reports from all networks are available typically after 1-2 months and annual reports after 2-12 months in the new year.

Greece

Information is only available from MA 1-2 questionnaire. More details are needed.

The national AQ monitoring network consists of 31 urban sites in 11 cities (incl. 11 sites in Athens-Attica and 5 in Thessaloniki), and one regional site. At all sites, gases are measured by monitors, and (most) SPM by manual samplers.

Coverage	:	The urban network probably covers most areas with air pollution problems. There is only one regional background site (also EMEP site). There are no regional O_3 sites.
Data availability	:	QC data are available after 1-2 months.
Reporting	:	Available after 4 months in new year.
Shortcomings/gaps	:	Regional O_3 (and O_3 precursor) sites are not established.

Ireland

Available information is from the MA 1-2 questionnaire, and from the "Guide to Air Pollution Monitoring Networks in the European Union (1990), Ireland". Info on data availability and reporting are missing.

20 local networks with a total of 88 sites are operated in 15 cities/counties. Of them, 6 sites are rural/regional (3 EMEP). In addition, there is a national O_3 network with 5 sites. This network, and the local Dublin network is part of a public information and alert system. Except for ozone, the sites are mainly equipped with manual (SO_2/BS) samplers.

Coverage : The SO_2/BS and ozone coverage is substantial. CO and VOC is not measured.

Italy

The available information has been extracted from various tables of stations and data provided by the Ministry of Environment. The available information was considerably less complete than from many of the other countries.

From this, there is a list of 129 sites in 41 cities/areas, with the following compound coverage:

SO_2	:	85 sites
NO_2	:	80 "
O_3	:	20 "
TSP	:	89 "
Pb	:	9 "
CO	:	49 "

There are 3 EMEP sites in Italy.

The Decree on collection of AQ data in Italy requires that cities/industrial areas establish monitoring systems with sites of various categories: urban background, traffic and industrial hot-spots, extra-urban background, regional background.

Luxembourg

Available info is from the MA 1-2 questionnaire. It seems to be fairly complete.

There is a national network with 6 sites, covering 2 urban areas and 2 rural/background sites. In addition, there are 2 industrial sites for dust deposition. Monitors are used, except for one site for SO_2/BS.

Coverage : Seems rather complete. Ozone is measured, and there is a site with ozone precursors.
Data availability : Quality controlled data available after 2 months.
Reporting : Annual reports available in February.

The Netherlands

The available information is rather complete, through MA 1-2 questionnaire, a site description report and national reports.

The national network includes an urban network with 20 sites in 9 cities, and a regional network with 36 basic sites (3 EMEP, 1 OSPARCOM, 1 TOR site) and 10 additional sites for NH_3 and precipitation.

Monitoring is used together with modelling to obtain a more complete air quality assessment.

Coverage	:	Substantial, especially when modelling is used in addition.
Data availability	:	Monitor data are available in near-real-time. Quality controlled data: after 1.5 months for monitor data, and 3 months after new year for integrated samples.
Reporting	:	Smog forecast: Twice a day. Annual summarising reports: Available in June.

Portugal

At the moment there are 84 AQ monitoring stations in Portugal which belongs to the following networks:

- Private networks associated to large industrial plants. There are 6 networks and the responsible for the measurements are the industries themselves.

- Local networks, which are 5, associated to urban and/or industrial areas. These networks are managed by Local Commissions for Air Management (CGAs) which are integrated in the Regional Directorates for Environment and Natural Resources (*CGA-Porto* in the North Regional Directorate, *CGA-Estarreja* in Center Regional Directorate, *CGA-Lisboa* and *CGA-Barreiro/Seixal* in Lisboa e Vale do Tejo Regional Directorate and *CGA-Sines* in Alentejo Regional Directorate).

- National network, with 15 stations, have been operated since 1986. Some of these stations also belong to the Local Networks. The national institution responsible for this network is the Meteorological Institute (IM).

- EMEP network with 5 stations.

- BAPMoN network with 8 stations.

Coverage	:	Substantial. The existing stations cover the main urban areas (cities of Lisboa, Porto, Coimbra, Setúbal and Faro), the industrial or urban/industrial areas (Barreiro/Seixal, Sines and Estarreja) and the areas within the influence of

large plants. However, it is still necessary to have more stations in some of these areas, principally in urban sites to obtain a better coverage. There are also some other places which are not yet covered. For these areas there have been made some campaigns for data collection with a mobile station.

Data availability : National network: available annually. Some data are published daily in newspapers.
Local network: available annually. By demand data from all networks can be provided after validation within a short delay. After all national stations have been connected to the central node, data will be available in near real time.

Reporting : Annual reports. No reports published since 1993.

Spain

Available info on monitoring networks and sites is from a complete network/site description report for 1992. Info on data availability and reporting is lacking.

There are 80 regional/local networks with a total of 1,070 sites, and a national network of 7 sites (1 reference site, 5 EMEP-BAPMON sites). The networks include 262 NO_x sites, 90 O_3 sites, 67 VOC sites and 76 meteorological sites.

Coverage : There is a large number of sites. Traffic and industrial hot-spot sites are well represented (438 and 167 sites resp.). There are totally 187 regional sites.

Sweden

Available info is from a data report on Urban Air Quality, from 1994.

There is an urban network covering 45 cities/towns (66 sites) operated by local authorities. The national network of regional air and precipitation quality includes 49 sites, of which 8 are EMEP sites. The urban network is equipped partly with monitors and partly with manual samplers (about 50 of each). The urban network includes 20 ozone sites with diffusive (passive) sampling on a monthly basis (6 months per year). EMEP includes 6 ozone sites equipped with monitors. Most of the 35 VOC sites are passive BTEX sampler sites. The others (3) are equipped with DOAS instruments.

Coverage : Substantial spatial coverage, but traffic and industrial hot-spot sites are not well represented (3 traffic sites in Stockholm, and no industrial sites). Temporal coverage: Many urban sites are operated only in the six winter months, and O_3 only in the summer months.

Data availability : Monitor data in principle available from the local networks, but no delay time given.

Reporting : Annual reports are prepared by The Swedish Environmental Research Institute (IVL). The urban

network report for the winter 1995/96 will be published in September 1996. EMEP 1995 data will be available in the spring 1996. Statistic Sweden yearly reports data from cities, in December from the last winter period.

Shortcomings/gaps : Urban air quality is in general not measured during summer, so annual averages can not be given.

United Kingdom

The available information is rather complete, through returned MA 1-2 questionnaire, data reports and other summary documents.

Air quality is monitored through national networks, of which there are 9 at present. The networks are compound/area-type specific, and have in principle a national coverage. Briefly mentioned the networks are (number of sites in brackets): Automatic Urban Network (25), Rural Ozone (15), Automatic VOC (9), Smoke and SO_2 (252), NO_2 diffusion tube (1,100), Lead etc. (15), Toxic organics (5), Acid dep. (32), Rural SO_2 (38). 19 EMEP sites (incl. 16 in the rural O_3 programme).

Local and regional pollution models are used to extend the assessment of the air quality.

Coverage : Substantial, both spatially, temporally and compound-wise. 34 cities are covered, and 4 industrial areas.

Methods : Standard/state-of-the-art/advanced (diffusion tubes for NO_2, on-line compound-specific VOC monitoring).

Data availability : Monitor data are available near-real-time (1-2 hours delay) on an Air Quality Bulletin System on Internet form the Department. of Environment.

- Acid dep. data : After 3-6 months.
- Rural SO_2 : After 3 months.

Reporting : Annual reports.

Trends : The Automated Urban Network is at present being extended substantially. There are plans for an external evaluation of the AQ monitoring programs.

EUROPEAN ECONOMIC AREA COUNTRIES

Iceland

Available information is from the MA 1-2 questionnaire, and a country report written by the Environment Protection in Iceland.

There are 4 urban sites in 3 cities/areas, and one rural (EMEP) site for S and N compounds in air and deposition (no rural ozone). In Reykjavik, SO_2, NO_2, CO, O_3 and PM_{10} is monitored. One of the 3 “sites” is in a mobile van. There is a traffic hot-spot site.

Coverage	:	Urban hot-spot (traffic, industry) and regional air pollution in Iceland seems to be covered by the present activities.
Data availability	:	Available in reports
Reporting	:	Annual reports
Shortcomings/gaps	:	Rural O_3 is not measured.

Liechtenstein

Information on AQ network is picked up from the 1994 AQ data report for Switzerland.

There is one monitoring station in operation, an urban site in Valdez, with monitors for SO_2, NO_x, NO_2, CO, O_3 and TSP (beta-absorption).

The result are reported in the Swiss annual data report.

Norway

The available information is complete, through NILUs involvement.

The urban air quality programme is designed to give data on population exposure, through combined use of monitoring and modelling. The urban network presently consists of 6 urban background sites (in as many cities). The regional background air and precipitation quality network consists of 39 sites (12 EMEP sites), of which 11 has monitoring of NO_2, 15 has O_3, and 11-13 has major ions. Hourly presentation of data to authorities is in operation in two cities (Drammen and Bergen).

Coverage	:	The coverage of the regional network is substantial. The urban network is not yet complete. The urban sites measure only NO_x, NO_2, $PM_{2.5}$ and PM_{10}. SO_2 conc. is very low, except for in some industrial locations. Most of the urban sites are operated only in the six winter months.		
Data availability	:	From monitors	:	near-real-time or daily (depending upon site). Quality controlled data: after one month.
		From samplers	:	Quality controlled data: after 2 months.
Reporting	:	Background network	:	Annual, after 10-12 months.
		Urban network	:	Reporting routines are not yet decided.
Shortcomings/gaps	:	The urban coverage is lacking. AQ is in general not measured during summer, so annual averages cannot be given.		
Trends	:	The urban network will most probably be expanded to more cities/towns. On-line monitoring and information system (AirQUIS), incl. possibility for on-line (hourly) presentation of monitoring and modelling results to the public, is being established in Oslo, and more cities may follow.		

OTHER COUNTRIES

Albania

Available info is only from the WABOLU/WHO questionnaire. It is not complete.

There is an urban monitoring network covering 11 cities, with a total of 23 sites (3 in Tirana). SO_2 and BS is measured at all sites, and in addition NO_x and TSP is measured at 3 of them.

Coverage	:	The network is operated throughout the year, but only 7-10 days per month. O_3 is not measured. There seems to be no regional/background sites.
Data availability	:	No information.
Reporting	:	No information.
Shortcomings/gaps	:	See “Coverage”.

Bulgaria

The available information is only from the WABOLU/WHO questionnaire. It is not complete.

The national network consists of about 100 sites, operated by Min. of health (39), Min. of Environment (55) and Hydro Met. Centre (6). The network covers cities, industrial towns and health resorts. It is unclear whether there are representative regional sites.

Coverage	:	The CSD compounds are covered with many sites (60-100), but there are no ozone sites. H_2S, and NH_3 is measured to a large extent, HCl, CO, Cl_2 are also measured at some sites. It is unclear to which extent the regional air quality is covered.
Methods	:	Standard.
Data availability	:	No information.
Reporting	:	No information.
Shortcomings/gaps	:	See “Coverage”.

Croatia

Available info is only from the WABOLU/WHO questionnaire. It is not complete.

There are local/regional networks covering 10 cities/industrial areas/populated regions, with a total of 62 sites. Most sites are urban and industrial, some may be regionally representative. There are manual samplers, no monitors. There are 2 EMEP sites (precipitation and NO_2).

Coverage	:	SO_2, NO_2, BS and TSP are covered, but no O_3 or lead sites. H_2S, NH_3, Phenols, PAH and Cl ion is also measured. It is unclear whether there are regionally representative sites.
Methods	:	Standard for BS and TSP. SO_2: "Acidimetric method (BSM)". NO_2, NH_3, H_2S, Phenols: Spectrophotometry.
Data availability	:	No information.
Reporting	:	No information.
Shortcomings/gaps	:	See "Coverage".
Trends	:	The network is under development, especially as regards regional sites. A central information system is contemplated.

Cyprus

Available info is from the MA 1-2 questionnaire. It seems fairly complete.

The air quality monitoring includes at present 3 sites, two traffic hot-spot sites in Nicosia, and one regional background site (EMEP/GAW).

Coverage	:	Spatial coverage is reasonable. All CSD compounds are covered, incl. PM_{10} continuously.
Data availability	:	From monitors : Near-real-time. Quality Controlled data : After 2 months.
Reporting	:	Annual reports available after 12 months. Data from background site available quarterly (delay unknown).

Czech Republic

Available info is from the MA 1-2 questionnaire, and from the Czech AQ report for 1993. Some information is lacking.

There are a number of national, regional and local networks in operation, with a total of about 650 sites. The Automatic Monitoring Network has 74 sites (37 urban, 37 rural) with monitors. The other sites have mainly manual samplers. There is a Special Monitoring Network for TSP and metals (14 sites, 11 rural, 3 urban). The networks cover in principle the whole territory. There are 2 EMEP stations.

Coverage	:	The spatial coverage is substantial. The CSD compounds are covered on very many sites, incl. 40 O_3 sites. CO is measured at 46 sites, and PM_{10} is also measured (at 3 sites). The entire network is operated the whole year.
Data availability	:	Quality controlled data are available from the Air Quality Information System at the Hydromet. Inst. after 3 months. Precipitation data are available after 2 months.
Reporting	:	Annual report available 4 months after new year.

Estonia

Available info is from some material received from the Estonian Environmental Research Laboratory. Some information is lacking.

The monitoring network includes an urban network with 16 sites in 9 urban areas (3 in Tallin), and 2 background (EMEP) sites.

Coverage	:	SO_2, NO_2 and TSP coverage is substantial. There are 3 O_3 sites (2 background and 1 urban), and 6 CO sites. H_2S, Formaldehyde, Phenols and NH_3 are measured at several sites, and BTX at 1 urban site. Traffic and industrial sites have monitors, the others manual samplers.
Data availability	:	No information.
Reporting	:	No information.

Hungary

Available info is from the MA 1-2 questionnaire. Information on cities and site classification is missing.

At present (since 1993) there is an urban network with 31 sites. In addition, Budapest has a smog alarm system with 8 sites. There are 2 background sites (1 EMEP site). The networks are equipped with monitors.

Coverage	:	SO_2, NO_x, CO and TSP is measured at all sites. O_3 and NMVOC is measured at 2 sites in Budapest. It is unknown whether traffic and industrial hot-spot sites are included.
Data availability	:	Quality controlled data after 3 months.
Reporting	:	Annual data reports after 12 months.

Poland

Available info is from the WABOLU/WHO questionnaire. Information on cities and site classification is missing.

Since 1990 several networks have been established. The General National Network includes more than 500 sites (incl. all cities >20,000 inhab.). The Basic National Network has 5 sites. Regional networks of Katowice and Krakow have 19 sites, and industrial networks (Kedzierzyn-Kozic and 7 other areas) have 33 sites. In addition there is an 8-city DOAS network. There are 11 regional sites (EMEP (4), GEMS, HELCOM).

Coverage	:	All CSD compounds are covered extensively. O_3 is measured at 25 sites, VOC at 34 sites, PM_{10} is measured, BTX at 8 sites, and CO at 26 sites. There are more than 3000 dustfall sites. In addition, H_2S, phenol, fluoride, HCHO, and BaP is also measured.

The sites are generally operated all year, but the General Network is operated on only 80-200 days of the year. The spatial coverage is substantial.

Data availability : No information.

Reporting : No information.

Romania

Available info is from the MA 1-2 questionnaire. Information on cities and site classification is missing.

There are 3 national and several local/regional networks. The national networks are the Regional network (5 sites), Precipitation quality network (133 sites) and Radioactivity network (44 sites). Local/regional networks operate 127 sites, incl. 25 in Bucaresti. 2 urban sites (Bucaresti) and 2 regional sites are equipped with monitors, the others with manual samplers.

Coverage : SO_2, NO_2 and SPM coverage is substantial, O_3 is measured at 5 sites, CO and VOC at 2 sites. In addition, NH_3 is measured all local sites (127). Also Cl_2, HCl, H_2S, HCHO, C_6H_5OH, furfurol, H_2SO_4, Cd is measured.
It is not known whether the 127 sites are operated every day.
The spatial coverage seems good. It is not known whether traffic hot-spots are represented.

Data availability : All information is available after 1-2 months. Daily data from monitors can be given.

Reporting : Data reports are available 6-12 months after sampling.

Slovakia

Available info is from the MA 1-2 questionnaire and the Slovakian AQ data report for 1993. The information is rather complete.

The national Urban network has (as of 1995) 30 sites in 17 urban areas (mostly urban background sites), incl. 4 in Bratislava area. The national Background Network has 7 sites. 4 EMEP sites.

Coverage : The urban sites have SO_2, NO_x, TSP, O_3 (13 sites), CO (8 sites), Pb (12 sites). The background network has SO_2, NO_x, major ions, HNO_3, SPM, heavy metals, O_3.
The networks are operated continuously all year.
The spatial coverage seems fairly good. Traffic and industrial hot-spot sites are well represented.

Data availability : Quality controlled data available after 2-3 months (Urban network: after 1 month).

Reporting : Annual report available by August the following year.

Slovenia

Available info is from the MA 1-2 and WABOLU/WHO questionnaires, and from the Slovenian AQ data report for 1991-92.

There are several national and local networks in operation. The National Basic Network (NAS) has 8 sites (7 urban and 3 regional (EMEP-GAW) site). The National Complementary Network has 7 sites and there is a national SO_2/Black Smoke network (NAMN) with 66 sites. There are some additional local networks with 7 sites, and a national precipitation network (PADAVINE) with 8 sites. NAMN and PADAVINE have manual samplers, the other sites have monitors.

Coverage	:	SO_2 and BS are covered well, there are 7 NO_x sites and 6 O_3 sites, 4 CO sites and 1 VOC site.
Data availability	:	ANAS is coupled to an information system, which includes early warning. Data availability is not clearly stated.
Reporting	:	Annual reports available in April-May.

Switzerland

Available info is from the MA 1-2 questionnaire, and the Swiss AQ data report for 1993.

The National Network (NABEL) operates presently 16 sites throughout the country, partly urban, traffic hot-spot and regional sites. 24 cantonal networks operates (1993) about 135 ordinary sites, and in addition sites for passive SO_2 and NO_2, and dustfall, 6 EMEP sites.

Coverage	:	CSD compounds are well covered. There are 131 O_3 sites, 2 VOC sites, 102 passive NO_2 and 12 passive SO_2 sites. Spatial and temporal coverage is substantial.
Reporting	:	Annual reports in July-August next year.

3.3 Summary of international monitoring programmes in Europe

The international monitoring programmes listed in Chapter 2.2 are described in Chapter 3.4 below. Table 3.4 gives a summary of the monitoring activities in these programmes.

Except for GEMS/AIR, which involves urban pollution, these programmes exclusively deal with regional and global air pollution problems. A large number of stations are involved in these programmes. Many of the stations are in operation under several of the programmes in parallel.

The compounds include S- and N-compounds, ozone, metals, and other trace gases. Table 3.5 shows which compounds are covered by which programmes.

Table 3.4: Summary of recent monitoring activities in Europe in international programmes.
For all programmes: Not all compounds are measured at all sites.

Programme	Sites	Countries	Compounds (summary)
EMEP (1995)	126	28	S- and N-compounds in air (gases and particles) and precipitation, and O_3 and VOC in air.
OSPAR (1994)			
Precip.	25	10	Cd, Hg, NO_3, NH_4, (priority) As, Cr, Cu, Ni, Zn, organo-halogens (grey list)
Aerosol/gas	12	6	Cd, Hg, a-HCN, g-HCN, HNO_3, NO_3, NO_2, NO, NH_3, NH_4 (priority) As, Cr, Cu, Ni, Pb, Zn (grey list)
HELCOM	31	8	N compounds in air (gases and particles), and in precipitation. Metals (Pb, Cd, Cu, Zn) in airborne particles and in precipitation. Cr, Ni, As, Hg in precipitation.
MEDPOL	13	10	Emphasis on heavy metals in aerosol, and heavy metals and major ions in precipitation.
GAW	61	23	Precipitation chemistry.
	100	29	"Trace gases": O_3 (81), NO_x (43), SO_2 (34), CO_2 (20), CH_4 (7), N_2O (3), CFCs (4).
	42	19	Aerosols
	16	5	Radiation
	14	10	Turbidity
TOR (1994)	29		O_3, NO, NO_2, NO_y, CH_4, CO, NMHC, J_{NO2}, met.data.
GEMS/AIR (1993/94)	9	9	SO_2, SPM

Table 3.5: Compound coverage in the international monitoring programmes.

	EMEP	OSPAR	HELCOM	MEDPOL	GAW	TOR	GEMS/AIR
S compounds	air precip.			precip.	SO_2 precip.		air (SO_2)
N compounds	air precip.	air	air precip.	precip	NO_X, N_2O precip.	air	
Metals		air precip	air precip.	aerosol precip.			
Ozone	x				x	x	
Organo-halogens		x					
CO_2					x		
CO						x	
CH_4					x	x	
VOC	x					x	
CFC					x		
"Aerosols", radiation, turbidity					x		TSP

3.4 International monitoring programmes, individual description

3.4.1 ECE-EMEP

As stated in Section 2.2.1, the purpose of the EMEP monitoring network is to provide a basis for control of the EMEP model to calculate transboundary fluxes, and not to provide sufficient monitoring data to map fully the gradients in regional air pollution in Europe. The EMEP network includes (1995) 126 monitoring stations in 28 countries. The monitoring programme (1995) is shown in Table 3.6. and Table 3.7. Table 3.3 summarises the regional air pollution monitoring network in each country. In most countries, the EMEP network is only a part of this total regional network.

An evaluation of the EMEP network relative to its objective has been performed (ECE, 1994). According to this evaluation, there are some shortcomings in the spatial coverage:

S and N compounds : The spatial coverage is considered insufficient in a number of areas of typical dimension 200-600 km (diameter) in various parts of Eastern, Western and Southern Europe. In addition, the whole area east of the 30°E longitude is considered insufficiently covered.

Ozone : EMEP ozone sites are lacking completely in much of Southern Europe, and east of the 30°E longitude. A number of new sites are recommended in those areas.

This evaluation concerns the sites reporting to EMEP which is to form a basis for model comparison. The total regional coverage is better when the other national sites are also considered. Still, however, the spatial coverage of regional monitoring is insufficient especially in parts of Southern, and most of Eastern Europe.

Table 3.6: Coverage of EMEP programme in participating countries.

Party	Complete EMEP programme	Precipitation programme complete	Air programme complete	Air programme except O_3	NO_2 sites	O_3 sites	NO_3, HNO_3, NH_4, NH_3 sites	Number of sites 31/12 - 95	Party
Austria	0	3	0	0	0	3	0	3	Austria
Belarus	0	0	0	0	0	0	0	0	Belarus
Belgium	0	0	0	0	0	0	0	0	Belgium
Bosnia-Herzegovina	0	0	0	0	0	0	0	0	Bosnia-Herzegovina
Bulgaria	0	0	0	0	0	0	0	0	Bulgaria
Croatia	0	2	0	0	2	0	0	2	Croatia
Czech Rep.	2	2	2	0	2	2	2	2	Czech Rep.
Denmark	0	0	0	1	1	2	3	5	Denmark
Estonia	0	0	0	0	0	0	0	0	Estonia
Finland	4	4	4	0	4	4	4	4	Finland
France	0	7	0	0	0	0	0	7	France
Germany	0	8	0	0	8	15	0	17	Germany
Greece	0	0	0	0	1	0	0	1	Greece
Hungary	0	1	0	1	1	0	1	1	Hungary
Iceland	0	0	0	0	0	0	0	1	Iceland
Ireland	0	2	0	0	1	1	0	3	Ireland
Italy	0	1	0	0	0	1	0	1	Italy
Latvia	0	0	1	0	2	1	1	2	Latvia
Lithuania	0	0	0	0	1	1	0	1	Lithuania
Macedonia, F. Yugoslav Rep. of	0	0	0	0	0	0	0	0	Macedonia, F. Yugoslav Rep. of
Moldova, Rep. of	0	0	0	0	0	0	0	0	Moldova, Rep. of
Netherlands	0	1	0	0	2	3	0	3	Netherlands
Norway	5	6	5	1	7	11	7	12	Norway
Poland	0	2	4	0	4	4	4	4	Poland
Portugal	0	3	0	0	0	1	0	4	Portugal
Romania	0	0	0	0	0	0	0	0	Romania
Russian Federation	0	4	0	0	4	0	0	4	Russian Federation
Slovak Rep.	0	4	0	0	4	3	0	4	Slovak Rep.
Slovenia	0	0	0	0	0	3	0	3	Slovenia
Spain	5	5	5	0	5	5	5	5	Spain
Sweden	3	4	3	1	6	6	5	8	Sweden
Switzerland	1	1	1	0	5	5	1	6	Switzerland
Turkey	1	1	1	0	1	1	1	1	Turkey

Table 3.6 (contd.)

Party	*Complete EMEP programme*	*Precipitation programme complete*	*Air programme complete*	*Air programme except O_3*	*NO_2 sites*	*O_3 sites*	*NO_3, HNO_3, NH_4, NH_3 sites*	*Number of sites 31/12 - 95*	*Party*
Ukraine	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*Ukraine*
United Kingdom	*2*	*5*	*2*	*0*	*0*	*16*	*2*	*19*	*United Kingdom*
Yugoslavia	*0*	*2*	*0*	*0*	*2*	*0*	*0*	*2*	*Yugoslavia*
CEC	*1*	*1*	*1*	*0*	*1*	*1*	*1*	*1*	*CEC*
Number of sites	*24*	*69*	*29*	*4*	*64*	*89*	*37*	*126*	*Number of sites*

Table 3.7: EMEP's measurement programme 1995–1998.

	Components	Measurement period	Measurement frequency
Gases	SO_2, NO_2, HNO_3, NH_3 O_3 Volatile organic compounds:* Light hydrocarbons C2–C7, ketones and aldehydes Hg**	24 hours 1 hour averages stored 10–15 minutes 8 hours To be decided	Daily Continuously Twice weekly Twice weekly To be decided
Particles	SO_4^{2-}, NO_3^-, NH_4^+ Trace metals**	24 hours To be decided	Daily To be decided
Gases + particles	$HNO_3 + NO_3^-$ $NH_3 + NH_4^+$ (separate measurements preferred) Persistent organic compounds**	24 hours 24 hours To be decided	Daily Daily To be decided
Precipitation	Amount, pH/H^+, SO_4^{2-}, NO_3^-, NH_4^+, Ca^{2+}, K^+, Cl^-, Na^+, Mg^{2+}, conductivity Trace metals** Persistent organic compounds**	24 hours To be decided To be decided	Daily To be decided To be decided

* At a limited number of sites only.

** Trace metals and persistent organic compounds (POP) are not yet included in the programme.

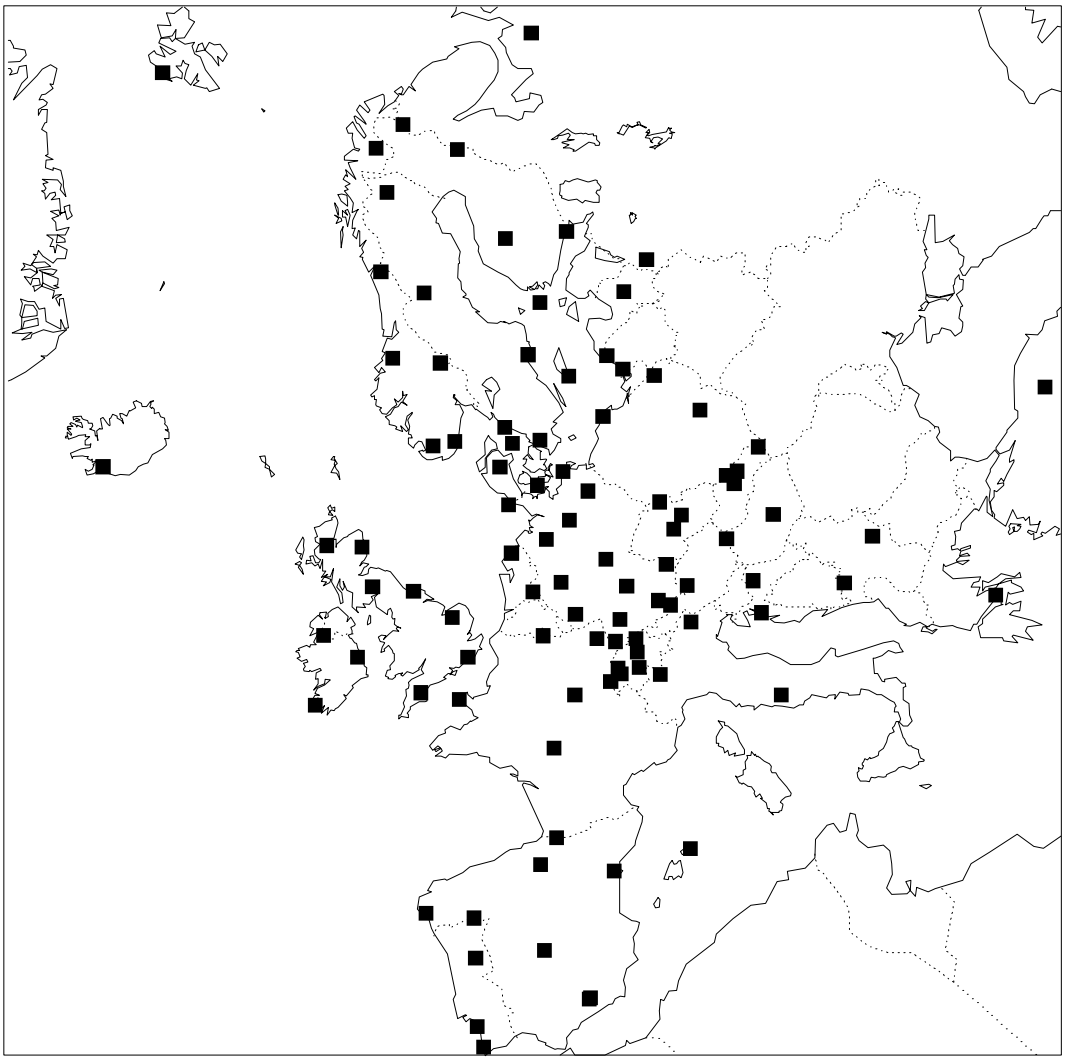


Figure 3.1: Location of EMEP stations (per 31.12.1995).
(Ozone sites not included).

3.4.2 Other

In this chapter, a brief description is given of the following monitoring networks:

- OSPAR, HELCOM, MEDPOL, GAW, TOR, GEMS/AIR

Some of the monitoring stations in these networks may be (probably are) the same as some of the regional stations described under each country in chapter 3.1/3.2. We have not, however, attempted to link these networks/stations to those described under each country previously.

- OSPAR/CAMP

  For 1994, data were reported for the following number of sites, and compounds (CAMP Secretariat, 1995):

  - Precipitation : 25 sites in 10 countries

Priority compounds : Cd, Hg, NO_3, NH_4

Grey list : As, Cr, Cu, Ni, Pb, Zn, organo-halogens.

- Aerosols and gases : 12 stations in 6 countries

Priority compounds : Cd, Hg, a-HCN, g-HCN, HNO_3, NO_3, NO_2, NO, NH_3, NH_4

Grey list : As, Cr, Cu, Ni, Pb, Zn.

The stations and measurement program are listed in Tables 3.8 and 3.9 for precipitation and aerosols/gases respectively. Figure 3.2 shows the position of a selection of the monitoring stations.

The stations are located mostly along the rim of the North Sea, the waters to be protected by the Convention.

The compound selection is concentrated around nutrients (N-compounds) and heavy metals. Organo-halogens are also measured at some stations. The sampling frequency is generally daily (24-hour samples), and the whole year is covered.

Recently, persistent organic pollutants have been included in the programme, and work on inputs to the North Sea of PCBs, PAH, pesticides and dioxins have started.

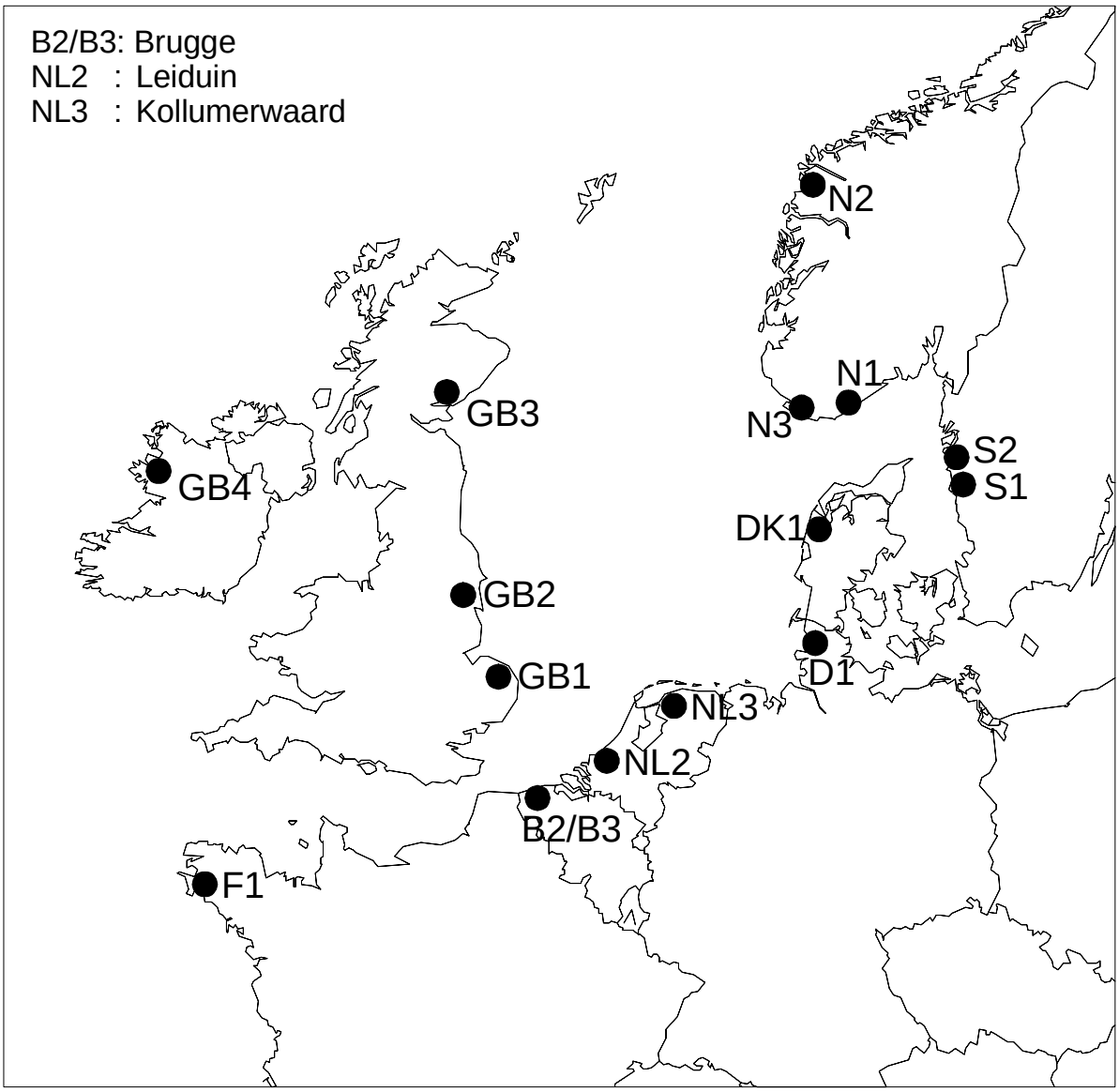


Figure 3.2: Location of 15 OSPAR/CAMP monitoring sites for aerosols and gases.

Table 3.8: Precipitation data submitted under OSPAR/CAMP 1994[1)].

Country	Station	Preci-pitation	Priority parameters						Grey list						
			Cd	Hg	a-HCH	g-HCH	NO_3-N	NH_4-N	As	Cr	Cu	Ni	Pb	Zn	Other
Belgium	Brugge	x	x				x	x			x		x	x	
France	Porspoder	x	x				x	x	x	x	x	x	x	x	
Germany	Westerland	x	x	x	x	x	x	x	x	x	x	x	x	x	o/halogens
Iceland	Irafoss Reykjavik	x	x				x			x	x	x	x	x	
Ireland	Turlough Hill Valentia	x	x	x	x	x	x	x	x	x	x	x	x	x	o/halogens
Netherlands	De Zilk Kollumer waard	x	x	x		x	x	x	x	x	x	x	x	x	
Norway	Lista Kårvatn Ny Ålesund	x	x	x	x	x	x	x	x	x	x	x	x	x	o/halogens
Portugal	Viana do Castelo	x	x				x	x			x	x	x	x	
Sweden	Gårdsjön Rörvik Svartedalen	x	x	x			x	x	x	x	x	x	x	x	o/halogens
United Kingdom	East Ruston Driby High Muffles Banchory Glen Dye Isle of Wight Chilton	x	x				x	x	x	x	x	x	x	x	o/halogens

1) The markings (x) represent the monitoring programme of each country.
For countries with more than one monitoring station, all compounds are not necessarily measured at all sites.

Table 3.9: Aerosol and gas data submitted under OSPAR/CAMP 1994[1)] .

Country	Stations	Priority parameters												Grey list						
		Cd	Hg	a-HCH	g-HCH	HNO_3-N	NO_3-N	HNO_3-N + NO_3-N	NO_2-N	NO-N	NH_3-N	NH_4-N	NH_3-N + NH_4-N	As	Cr	Cu	Ni	Pb	Zn	Other
Belgium	Houtem Moerkerke								x	x								x		
Germany	Westerland	x					x		x			x				x		x		V??
Netherlands	Kollumer waard	x					x		x	x	x	x		x				x	x	
Norway	Lista Kårvatn Ny-Ålesund	x	x	x	x			x	x				x	x	x	x	x	x	x	
Sweden	Rörvik																			Organics
United Kingdom	East Ruston High Muffles Banchory Isle of Wight	x												x	x	x	x	x	x	

1) The markings (x) represent the monitoring programme of each country.
For countries with more than one monitoring station, all compounds are not necessarily measured at all sites.

HELCOM

The monitoring network under the HELCOM Commission consists totally of 31 stations in 8 countries. The location of 26 of those stations is shown in Figure 3.3, located mainly along the rim of the Baltic Sea (HELCOM, 1991).

The recommended list of parameters for the monitoring of "airborne pollution load" is as follows:

		"Routine Minimum Requirements"	"Experimental"
N	NO_3^- precipitation	+	
	NH_4^+ precipitation	+	
	NO_2 gas	-	+
	HNO_3 gas + NO_3^- particles	-	+
	NH_3 gas + NH_4^+ particles	-	+
Pb	precipitation	+*)	
	particles	-	+
Cd	precipitation	+*)	
	particles	-	+
Cu, Zn	precipitation	+*)	
	particles	-	+
Cr, Ni, As and Hg	precipitation	-	+

\+ monitored on routine or experimental basis
\- not monitored on routine basis
*) monitored on routine basis, from at least one station of each country

Regarding data quality, the countries are requested to "apply reliable analytical procedures", and to report all major ion concentrations in precipitation, to check the ion balance of the results.

The HELCOM data base covers the period from 1983-1984, and coverage is rather complete for a majority of the stations.

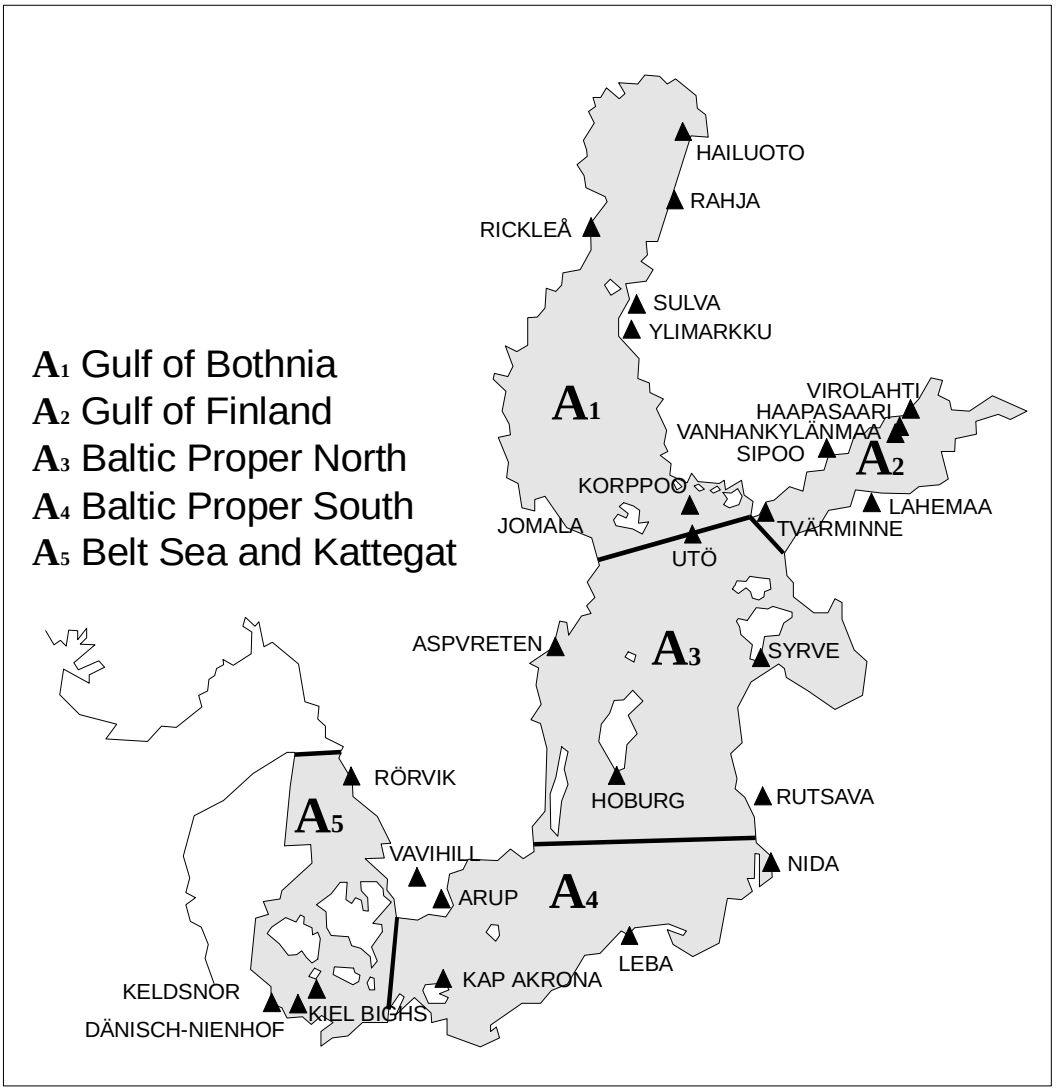


Figure 3.3: Location of HELCOM stations.

MEDPOL

In the MEDPOL monitoring programme, a total of 13 stations in 10 countries are operated (1993). Figure 3.4 indicates the location of the stations along the coast of the Mediterranean Sea. The programme includes, as for OSPAR/CAMP and HELCOM, precipitation and aerosol, and gases at some stations.

The emphasis of the program is on heavy metals in aerosol and in precipitation, together with major ions in precipitation.

An overview of the data reported from the individual stations is given in Tables 3.10 and 3.11 for aerosol and precipitation respectively (WMO, 1994). Regarding data quality, recommendations are given in the programme on sampling and analytical procedures.

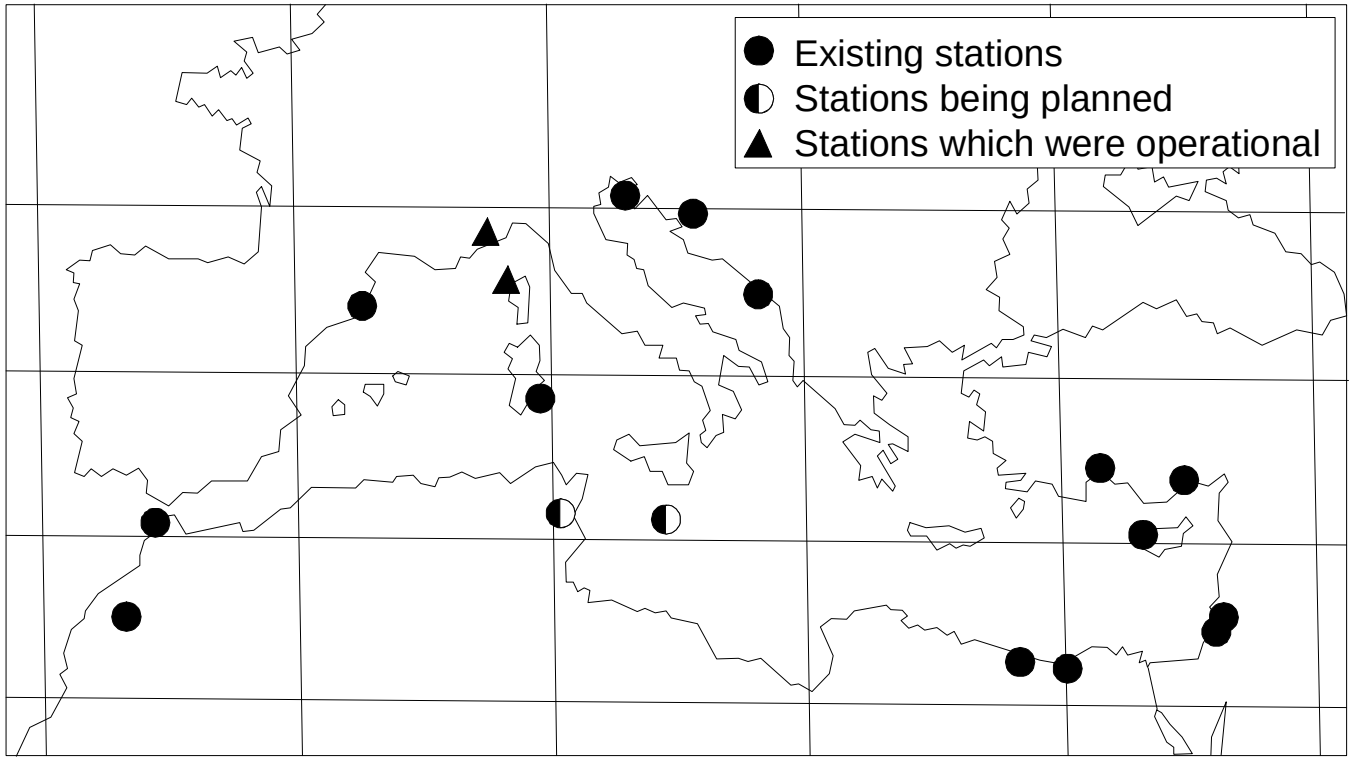


Figure 3.4: Location of MEDPOL airborne pollution stations (Ref.: WMO, 1994).

Table 3.10: Summary characteristics of stations for deposition sampling and analysis in the MEDPOL programme.

COUNTRY	STATION	PARAMETERS	FREQUENCY	EQUIPMENT	ANALYTICAL
FRANCE (1)	Background	Major ions, pH, conductivity, soluble and insoluble elements	Event by event during campaigns	Wet only collector; Home-made collector	Ion Chr., AAS, XRF
FRANCE (2)	Background	Al, Si, P, Na, Mn, Fe, Zn, Pb	15 days, for 3 years	Bulk (preacidified)	AAS, XRF
MOROCCO (1) (Beni Mellal)	Background	Pb, Cd, Zn, Cu, SO_4, NO_3	Event	Wet-only	AAS, UV-spectr.
MOROCCO (2) (Tangiers)	Regional	Pb, Cd, Zn, Cu, SO_4, NO_3	Event	Wet-only	AAS, UV-spectr.
ISRAEL (1)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S, conductivity	Daily	Wet-only	ICP
ISRAEL (2)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S, conductivity	Daily	Wet-only	ICP
ITALY	Background	pH, conduc., Ca, Mg, Na, K, Mn, NO_3, SO_4, Cl, alkal.	Event	Wet and dry	Ion Chr., ICP, AAS
TURKEY (1) (Antalya)	Background	pH, SO_4, NO_3, Cl, NH_4, metals	Daily	Wet and dry (ions) Wet only (metals)	Ion Chr., AAS
TURKEY (2) (Erdemli)	Background	pH, cond., NO_3, PO_4, Ca, Na, Mg, Pb, Cd, Zn, Fe, Mn	Event	Wet and dry	AAS, Colorimetry
CROATIA	Background	pH, Cond., HCO_3, Cl, SO_4, NO_3, NH_4, F, Na, K, Ca, Mg	Daily, monthly	Bulk	AAS, UV-Spect., Titrimetric
TUNISIA (currently not operational)	Background	Cd, Pb, Zn, Cu, pH, Cl, SO_4, NO_3, NH_4, Na, K, Ca, Mg	Weekly		
YUGOSLAVIA	Coastal (regional)	Cd, Pb, Zn, Cu, pH, conduct., Cl, SO_4, NO_3, NH_4, Na, K, Ca, Mg	Daily	Bulk	AAS, Spectrophotometry
SLOVENIA	Regional	pH, conduct., Cl, SO_4, NO_3, NH_4, Na, K, Ca, Mg	Monthly	Bulk	Flame photometry, Spectrophotometry
CYPRUS	Background	Cd, Pb	Event	Wet only (KFA)	AAS (graph. Furn.)

1) Stations from countries which responded to WMO questionnaire are included in the table.

Table 3.11: Summary characteristics of stations for aerosol sampling and analysis in the MEDPOL programme.

COUNTRY	STATION	PARAMETERS	FREQUENCY	EQUIPMENT	ANALYTICAL
FRANCE	Background	Na, Al, Si, P, S, Cl, K, Ti, Mn, Fe, Zn, Pb	Daily continuous	Low-Vol Sampler, Nucleopore filter	XRF except for Na, Zn, Pb (AAS)
MOROCCO (1) (Beni Mellal)	Background	Pb, Cd, Zn, Cu, SO_4	Monthly	Hi-Vol Sampler, Glass fibre filter	AAS, S (UV-spec)
MOROCCO (2) (Tangiers)	Regional	Pb, Cd, Zn, Cu, SO_4	Monthly	Hi-Vol Sampler, Glass fibre filter	AAS, S (UV-spec)
ISRAEL (1)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S	Weekly	Hi-Vol Sampler (Aquero), Glass fibre filter	ICP
ISRAEL (2)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S	Weekly	Hi-Vol Sampler (Aquero), Glass fibre filter	ICP
ITALY	Background	Ca, Mg, K, Mn, Pb, Zn, (soluble) Ca, Mg, Na, Si, Al, Fe, K, Cu, Pb, Zn, Cd (insoluble)	3 days	Hi-Vol Sampler (Andersen), Whatman 41 and Polyester filters	AAS (Graph. Fur.)
TURKEY (1) (Antalya)	Background	Al, Na, Cd, Zn, Sb, Pb, As, Se, V, Ni, SO_4, NO_3, Cl, NH_4	Daily	Hi-Vol Sampler (Andersen), Impactor (Sierra) Whatman 41 and nucleopore filters	AAS, INAA
TURKEY (2) (Erdemli)	Background	Al, Fe, Mn, Ca, Na, Mg, Cr, Ni, Zn, Cd, Pb, V, NO_3, PO_4	1-2 days	Hi-Vol Sampler (Andersen) Whatman 41 filter	AAS
CROATIA	Background	SO_2, NO_2, Cl		Glass, Polyethylene	
TUNISIA (currently not operational)	Background	Cd, Pb, Zn, Na, Al, SO_4, ^{137}Cs	Weekly		
YUGOSLAVIA	Coastal (regional)	SPM	Daily	Hi-Vol sampler (Aquero) Glass fibre filter	AAS, Spectrophotometry
SPAIN	Background	SPM, nutrients (nitrate, nitrite, ammonia, phosphates, silicates)	Daily	Hi-Vol sampler (Strohlein, HVS-150)	Colorimetry
CYPRUS	Background	Cd, Pb, PAH	Monthly	Hi-Vol Sampler	AAS, HPLS

Table 3.11: Cont.

Information required	Approach	Sampling duration[1)]	Sampling frequency[2)]	Supplementary data needed	Parameters of interest	Sampler type	Filter type
Assessment of deposition on monthly basis	Bulk deposition sampling	2 weeks	Continuous	Local met. data	Cd, Pb, Cu, Zn, Al, Na	Bottle and funnel sampler	None
Assessment of long term trends in concentration over long periods	Aerosol measurements	1 week (or for 3 days every week)	Continuous	Local met. data	Cd, Pb, Cu, Zn, Al, Na	Hi-Vol sampler at reduced flow rate	GFF[3)]
Assessment of wet vs. dry deposition	Simultaneous wet-only and bulk sampling, or wet and dry sampling[4)]	2 weeks	Continuous	Local met. data	Cd, Pb, Cu, Zn, Al, Na	Wet-only + bottle and funnel, or wet and dry sampler	None
Assessment of wet and dry deposition and identification of the origin of the particulate matter	Simultaneous wet-only + bulk (or wet and dry) deposition and aerosol sampling	**Aerosols** 1-3 days (preferably 1-day) **Wet only** 1-day or event **Bulk** 1-week	Continuous	Size separated concentrations Back trajectories	Cd, Pb, Cu, Zn, Al, Na id. (plus major ions) id.	Wet-only + bottle and funnel (or wet and dry) sampler Hi-Vol sampler	W-41[5)]

1) Sampling duration, refers to the time interval in which samplers remain operational
2) Sampling frequency refers to the frequency of sampling in one year
3) Glass fibre filter
4) Dry and wet sampling refers to separate collection of wet-only and dry deposition samples
5) Whatman-41 cellulose filter

GAW

There are (1993) 157 GAW stations in operation in Europe (Region VI) (WMO, 1993). Two of them is defined as “global (baseline)” stations (Pallas-Sodankylä in Finland and Schauinsland/Wank/Zugspitze in Germany (for different compounds)), the rest are “regional”.

- 61 stations in 23 countries measure precipitation chemistry.

- 100 stations in 29 countries measure the trace gases “in general”, of which 81 stations measure O_3, 43 stations measure NO_x, 34 stations measure SO_2, 20 stations measure CO_2, 7 stations measure CH_4, 3 stations measure N_2O, and 4 stations measure CFCs.

- 42 stations in 19 countries measure aerosols (mainly aerosol/particle mass), but some stations measure carbon black, physical characteristics such as size distribution, volatility, scattering, chemical composition, and turbidity.

- 16 stations in 5 countries measure radiation.

- 14 stations in 10 countries measure turbidity.

Figure 3.5 indicates the location of stations in Europe. The sampling programme and names of stations is given in Table 3.12.

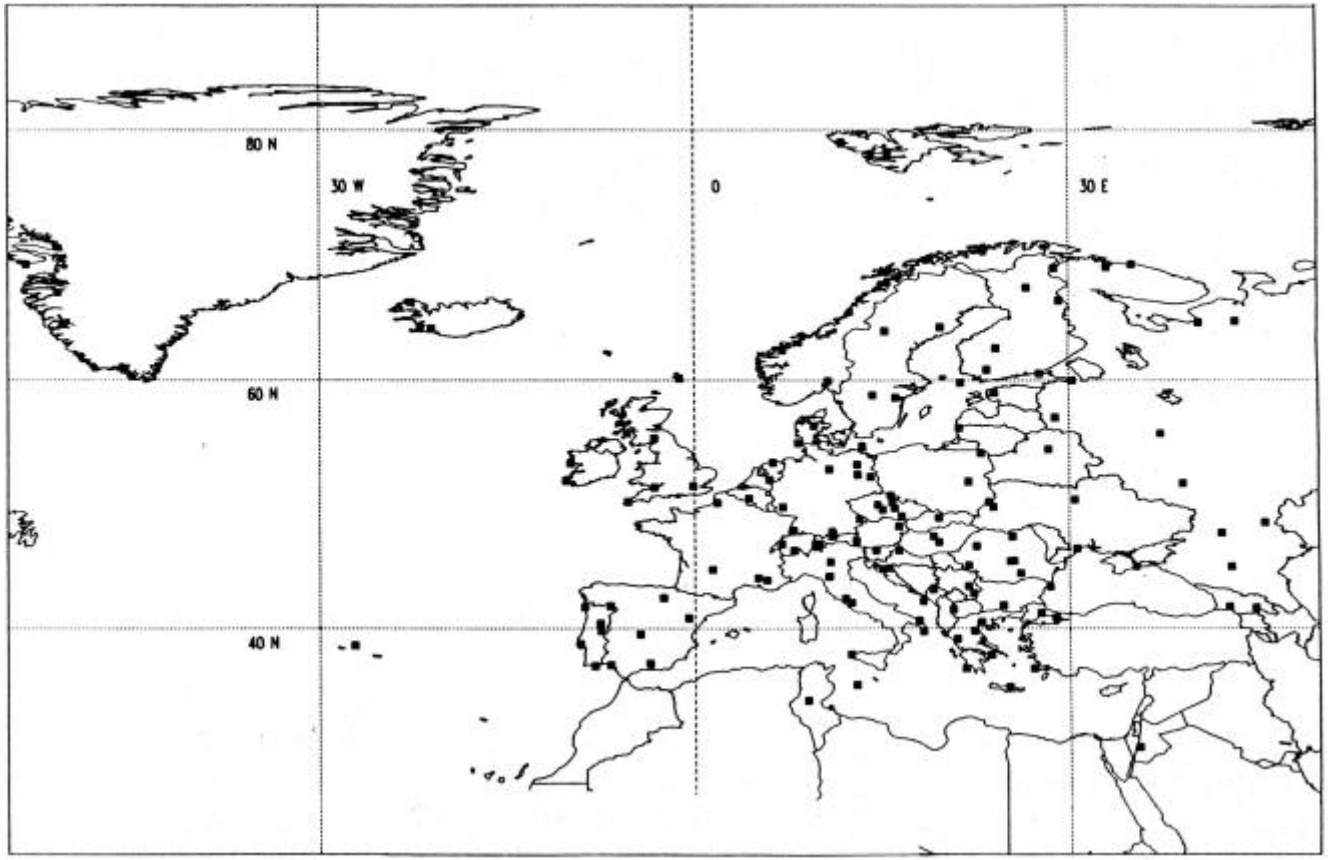


Figure 3.5: GAW stations in Region VI - Europe, as per 31 December 1993. (Ref.: WHO, 1993b.)

Table 3.12: GAW measurement programme in Region VI - Europe. (Ref.: WHO, 1993b.)

Country	Number of stations		Names of stations measuring														
	Estab	Active	Aerosols	Trace Gases G (i)											Precipitation Chemistry	Radiation	Turbidity
				1	2	46-49	12	51	3-9 19-29	43-45	83	15	57	72			
				In general	CO_2	O_3	CH_4	N_2O	CFCs	NO_2	H_2O	CH_3CCl_3	$^{14}CO_2$	SO_2			
Austria	3	2		Sonnblick Wien	Sonnblick	Sonnblick Wien	Sonnblick			Sonnblick							
Belarus	1	1		Berezinskii B.R.		Berezinskii B.R.					Berezinskii B.R.				Berezinskii B.R.	Berezinskii B.R.	Berezinskii B.R.
Belgium	1	1		Uccle													
Bulgaria	8	0															
Croatia	3	2		Varazdin Zavizan						Varazdin Zavizan				Varazdin Zavizan			
Czech Republic	4	4	Kosetice Svratouch	Hradec Kralove Kosetice Praha Svratouch	Kosetice	Hradec Kralove Kosetice Praha				Kosetice Svratouch				Kosetice Svratouch	Kosetice Svratouch		
Denmark	4	4		Søndre Strømfjord		Søndre Strømfjord									Edje Godhavn Tange		
Finland	6	6	Ahtari Oulanka Utö Virolahti	Ahtari Oulanka Pallas-Sodankylä Utö Virolahti		Ahtari Oulanka Pallas-Sodankylä Utö Virolahti				Ahtari Pallas-Sodankylä Utö Virolahti				Ahtari Oulanka Utö Virolahti	Ahtari Jokioinen Oulanka		
France	4	4		Haute Provence		Haute Provence									Abbeville Carpentras Gourdon		Carpentras
Georgia	2	2		Abastumani Tbilisi		Abastumani Tbilisi											
Germany	13	13	Arkona Brotjacklriegel Deuselbach Neuglobsow Schauinsland Waldhof Westerland	Arkona Brotjacklriegel Garmisch-Partenkirchen Hohenpeiss-enberg Lindenberg Neuglobsow Potsdam Schauinsland Waldhof Wank Westerland Zugspitze	Brotjacklriegel Deuselbach Neuglobsow Schauinsland Waldhof Wank Westerland Zugspitze	Arkona Brotjacklriegel Deuselbach Garmisch-Partenkirchen Hohenpeiss-enberg Lindenberg Neuglobsow Potsdam Schauinsland Waldhof Wank Westerland Zugspitze	Schauins-land Zugspitze	Schauins-land		Brotjacklriegel Deuselbach Hohenpeiss-enberg Lindenberg Neuglobsow Schauinsland Waldhof Wank Westerland Zugspitze				Brotjacklriegel Deuselbach Hohenpeiss-enberg Lindenberg Neuglobsow Schauinsland Waldhof Wank Westerland	Deuselbach Hohenpeiss-enberg Neuglobsow Schauinsland Waldhof Wank	Arkona Hohenpeiss-enberg Potsdam Schauinsland Wank Zugspitze	Lindenberg Potsdam
Greece	9	7	Thessaloniki	Thessaloniki		Thessaloniki				Thessaloniki					Methoni	Attica Halkidiki	Thessaloniki

Table 3.12 (contd.)

Country	Number of stations		Names of stations measuring														
	Estab	Active	Aerosols	Trace Gases G (i) 1	2	46-49	12	51	3-9 19-29	43-45	83	15	57	72	Precipitation Chemistry	Radiation	Turbidity
				In general	CO_2	O_3	CH_4	N_2O	CFCs	NO_2	H_2O	CH_3CCl_3	$^{14}CO_2$	SO_2			
Greece (contd.)	9	7														Heraklion Komotini Kos Thessaloniki	
Hungary	2	2	K-Puszta	Budapest-Lorinc K-Puszta	K-Puszta	Budapest-Lorinc K-Puszta				K-Puszta				K-Puszta	K-Puszta	K-Puszta	
Iceland	3	2	Irafoss	Irafoss Reykjavik		Reykjavik								Irafoss	Irafoss		
Ireland	2	2	Mace Head Valentia	Mace Head Valentia	Mace Head	Mace Head Valentia	Mace Head	Mace Head	Mace Head	Mace Head Valentia				Valentia	Mace Head Valentia	Mace Head Valentia	Valentia
Italy	10	8	Monte Cimone	Brindisi Cagliari/ Elmas Monte Cimone Sestola Vigna di Vale	Monte Cimone	Brindisi Cagliari/ Elmas Sestola Vigna di Vale	Monte Cimone								Monte Cimone Trapari/Birgi Verona Viterbo		Monte Cimone Verona Viterbo
Jordan	1	1													Shoubak		Shoubak
Latvia	2	2	Rutsava	Riga Rutsava		Riga Rutsava									Rutsava		
Macedonia F.Y.Rep.of	1	1		Lazaropole										Lazaropole	Lazaropole		
Netherlands	1	1		De Bilt		De Bilt											
Norway	4	4	Ny-Ålesund/ Spitsbergen	Longyearbyen Ny-Ålesund Oslo Tromsø		Longyearbyen Ny-Ålesund Oslo Tromsø	Ny-Ålesund	Ny-Ålesund	Ny-Ålesund					Ny-Ålesund	Ny-Ålesund		
Poland	4	4	Jarczew Leba Sniezka Suwalki	Jarczew Sniezka Suwalki					Suwalki	Jarczew Sniezka				Jarcew Sniezka Suwalki	Jarcew Sniezka Suwalki		
Portugal	7	7	Angra Do Heroismo Braganca Castello Branco Faro Viana Do Castelo	Angra Do Heroismo Funchal Lisboa Penhas Duradas	Angra Do Heroismo Funchal Lisboa Penhas Duradas	Angra Do Heroismo Funchal Lisboa Penhas Duradas									Angra Do Heroismo Braganca Castello Branco Faro Viana Do Castelo		
Romania	6	6		Bucharest Fundsta Predeal Rareu		Bucharest Fundsta Predeal Rareu				Bucharest Fundsta Predeal Rareu					Bucharest Fundsta Predeal Rareu		

Table 3.12 (contd.)

	Number of stations		Names of stations measuring														
	Estab	Active	Aerosols	Trace Gases G (i) 1	2	46-49	12	51	3-9 19-29	43-45	83	15	57	72	Precipitation Chemistry	Radiation	Turbidity
				In general	CO_2	O_3	CH_4	N_2O	CFCs	NO_2	H_2O	CH_3CCl_3	$^{14}CO_2$	SO_2			
Romania (contd.)	6	6		Semenic Stina de Vale		Semenic Stina de Vale				Semenic Stina de Vale					Semenic		
Russian Federation	23	23	Pinega Yaniskoski	Arkhangelsk Barentsburg Bering Is Kheysa Is Moscow Murmansk Pechora Kamchatskii Pinega St. Petersburg Samara Teriberka Tsimlyarsk Volgograd Voronezh Yaniskoski	Bering Is. Teriberka	Arkhangelsk Barentsburg Kheysa Is Moscow Murmansk Pechora Kamchatskii Pinega St. Petersburg Samara Teriberka Tsimlyarsk Volgograd Voronezh				Arkhangelsk Barentsburg Yaniskoski				Yaniskoski	Pinega Pushkinskiye Gory Pyatigorsk Syktyvkar Voronezh Yaniskoski Yasnaya Polyana		Pyatigorsk Syktyvkar
Slovakia	4	2	Chopok	Chopok Ganouce		Ganouce				Chopok				Chopok			
Slovenia	1	0															
Spain	5	3	La Cartuja Logroño Roquetas	La Cartuja Logroño Roquetas						La Cartuja Logroño Roquetas				La Cartuja Logroño Roquetas	La Cartuja Logroño Roquetas		
Sweden	4	3	Sjöangen	Norrköping Vindeln		Norrköping Vindeln											
Switzerland	4	4	Jungfraujoch Payerne	Arosa Jungfraujoch Payerne		Arosa Jungfraujoch Payerne				Payerne				Jungfraujoch Payerne	Payerne		Davos
Ukraine	6	5	Rava-Russkaya	Feodosiya Kiev Lvov Odessa		Feodosiya Kiev Lvov Odessa									Rava-Russkaya		
UK	6	5	Eskdalemuir Lerwick	Camborne Eskdalemuir Lerwick Sibton	Sibton	Camborne Lerwick Sibton	Lerwick			Camborne Eskdalemuir				Camborne Eskdalemuir	Eskdalemuir Lerwick		Ocean Station “L”
Yugoslavia	3	3		Kamenicki-Vis Zabljak						Kamenicki-Vis Zabljak					Herceg-novi Kamenicki-Vis Zabljak		
Total No. Stations	157	134	42	100	20	81	7	3	4	43	1			34	61	16	14
Countries	32	30	19	29	9	24	6	3	4	16	1			15	23	5	10

TOR

In 1994, there were a total of 29 stations in the network doing ground-based measurements, as shown in Table 3.13. In addition, there were 5 sounding stations. Many of the stations are part of other programmes, and were already in operation before TOR started. The measurement program is given in Table 3.14, as it was in 1992. The location of the stations is indicated on the map in Figure 3.6.

The monitoring programme includes the compounds O_3, NO, NO_2, NO_y, CH_4, CO, NMHC, J_{NO_2} and meteorological data.

The last operating year of the TOR network was 1994. However, most of the stations, if not all, are still in operation under other programmes.

Table 3.13: TOR stations, 1994.

Northern Europe	**Central Europe**
Ny-Ålesund	Donon
Åreskutan	Schauinsland
Utö island	Jungfraujoch
Aspvreten	Zugspitze
Birkenes	Wank
Rörvik	Sonnblick
Lille Valby	Krvavec
	Puntijarka
Western Europe	Zagreb-RBI
Mace Head	K-Puszta
Porspoder	
Brennilis	**Southern Europe**
Weybourne	Pic du Midi
Kollumerwaard	Penh. Douradas
	Lisbon-INMG
	Angra do Heroismo
	Funchal
	Izana
	Athens
Sounding stations	
Hungriger Wolf	
Jülich	
Uccle	
Garmisch	
Haute Provence	

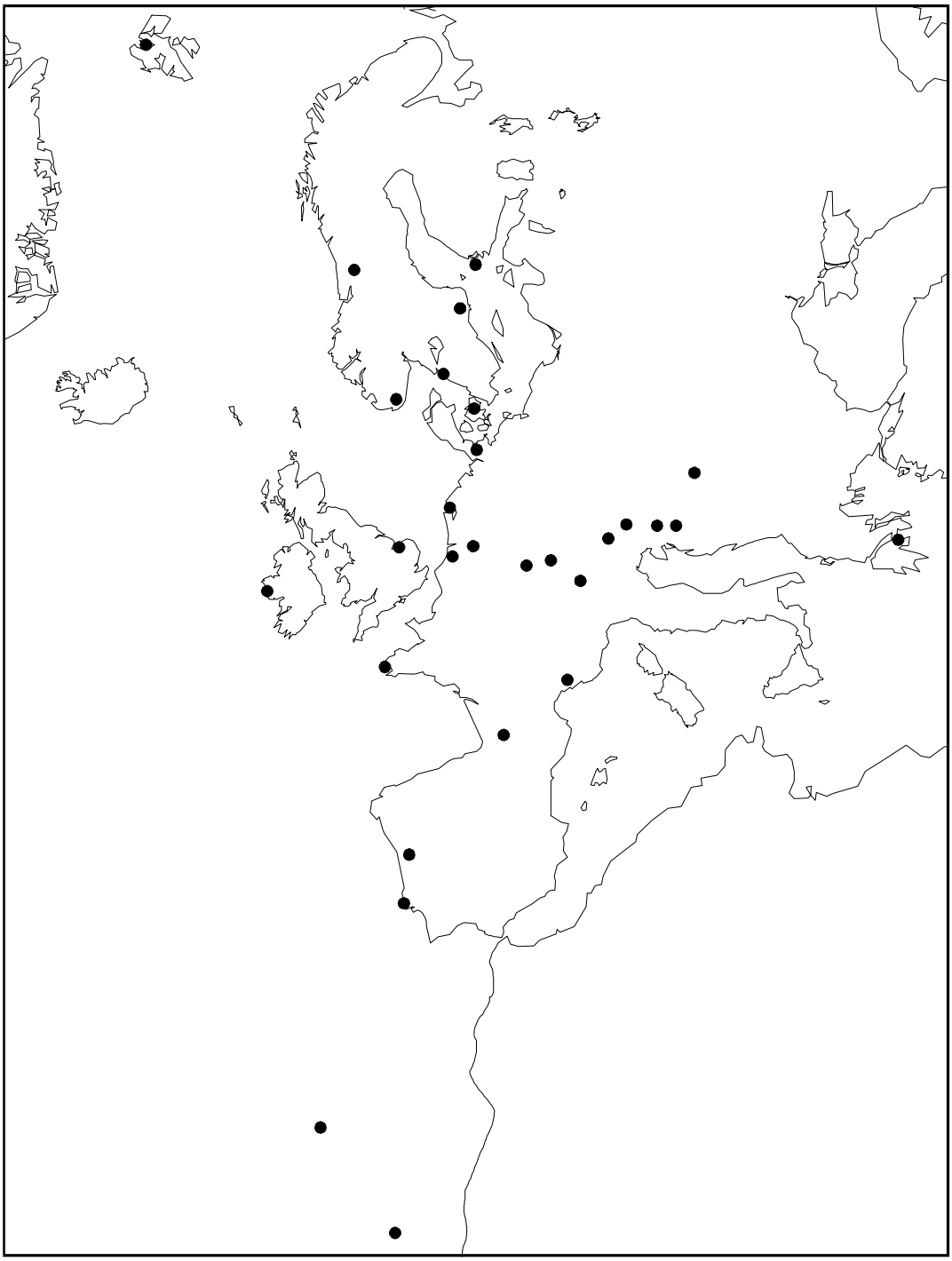


Figure 3.6: Locations of TOR stations, 1994. (Ref.: Cvitaš and Kley, 1994).

TOR station #	Name of site	Principal Investigator(s)	O_3	NO	NO_2	NO_Y	CH_4	CO	NMHC C_2-C_5	NMHC > C_5	J_{NO2}	Met-data
1	Ny Ålesund	Ø. Hov	CO	CO	CO	CO	W3	CO	W3	W3	CO	CO
2	Birkenes	Ø. Hov	CO	-	W7	-	W3	-	W3	W3	-	CO
3	Utö island	T. Laurila	d24	d24	d24	-	W3	-	W3	-	d24	d24
4	Åreskutan	P. Oyola	CO	-	-	-	-	-	-	-	-	-
5	Rörvik	A. Lindskog	CO	CO	CO	-	-	-	d6	d6	-	CO
7	Weybourne	S.A. Penkett	CO	CO	CO	CO	-	CO	OC	OC	CO	CO
8	Mace Head	P. Simmonds	d24	-	-	-	d12	d24	-	-	-	-
9	Kollumerwaard	J. Beck	CO	CO	CO	-	CO	CO	CO	-	CO	CO
10	Porspoder	G. Toupance	CO	CO	CO	-	-	-	d24	d24	CO	CO
11	Schauinsland	A. Volz-Thomas D. Kley	CO	CO	CO	CO	-	CO	d8	d8	CO	CO
12b	Wank	H. Scheel W. Seiler	CO	CO	CO	CO	-	-	-	-	-	CO
12c	Zugspitze	H. Scheel W. Seiler	CO	CO	CO	-	d72	d72	-	-	CO	CO
13	Sonnblick	H. Puxbaum K. Radunsky	CO	-	-	-	-	-	-	-	-	CO
14	Pic du Midi	A. Marenco	CO	see notes	see notes	see notes	-	d48	-	-	-	-
15	K-Puszta	L. Haszpra	CO	-	W7	-	-	-	W1	W1	-	CO
16	RBI	L. Klasinc	CO	CO	CO	-	-	-	-	-	CO	CO
17	Izana	R. Schmitt	CO	CO	CO	CO	CO	see notes	see notes	see notes	CO	CO
18	Jungfraujoch	L. Delbouille	see notes									
19	Aspvreten	P. Oyola	CO	CO	CO	CO	-	CO	OC	-	CO	CO
20	Donon	G. Toupance	CO	CO	CO	-	-	-	-	-	-	CO
21	Lille Valby	T. Nielsen	d48	d48	d24	d48	-	-	OC	-	-	CO
25	UK-network	M.L. Williams J.S. Bower										
27	Puntijarki	L. Klasinc	CO	-	-	-	-	-	-	-	-	CO
?	Kravec	B. Gomiscek	CO	-	-	-	-	-	-	-	-	CO

Table 3.14: TOR stations, measurement program, 1992. (Ref.: Kley et al., 1993.)

AMAP

The activities in AMAP covers several environmental media (air, water, marine and terrestrial ecosystems, and effects on these). There are 5 monitoring stations for air associated with AMAP: Ny Ålesund at Spitzbergen, Nord on Greenland, Pt. Barrow in Alaska, Alert in Canada, and Wrangel Island in Russia. Of these, only Ny Ålesund is located within the European Arctic.

At Ny Ålesund, the measurement program covers acidity, heavy metals and persistent organic pollutants (POP) such as pesticides (α and γ HCH, chlordanes, DDT) PCBs, PAH.

GEMS/AIR

Programme

Table 3.15 shows the cities in Europe which have been involved in the GEMS/AIR programme since about 1970. As the table shows, only 9 cities have reported data for 1993 and/or 1994 to the central GEMS data base.

It is safe to assume that the monitoring sites in the cities of Table 3.15 which report to GEMS, are in operation under other, national monitoring networks, and are thus included in the network descriptions of Appendix B and in Tables 3.2 and 3.3.

The GEMS/AIR programme is so far restricted to monitoring SO_2 and SPM.

Data quality assurance

Data validation and the reliability and comparability of the monitoring data is considered a crucial element of the programme. This will be achieved by means of collaborative reviews through UNEP/WHO Regional Support Centres which will be performed in South America, South East Asia, Northern and Sub Saharan Africa and Eastern Europe.

Data storage, representation and access

Data are presently put into a database from hard copy and via the GEMSDATA PC programme. The database is the Aerometric Information Retrieval System AIRS of USEPA in which the air quality data are stored under the auspices of UNEP/WHO. As the use of the GEMSDATA diskette requires some manipulation to transfer the data into the AIRS format; in the future a PC programme GEMSAIRS will be used in order to transfer the data from an ASCII format directly to the AIRS interface. AIRS then will provide a data presentation on the basis of a geographical information system. It is planned to have access to the data via the Internet.

Table 3.15: GEMS/AIR network stations in Europe.

Country	City	Last year of reporting
Austria	Retz	1971
Belgium	Brussels	
Croatia	**Zagreb**	**1993**
Czechoslovakia	Praha	1978
Denmark	Copenhagen	1986
Finland	**Helsinki**	**1993**
France	Toulouse	1984
	Gourdon	1984
Germany	**Frankfurt**	**1994**
Greece	**Athens**	**1994**
Ireland	Dublin	1990
Italy	Milan	1983
Luxembourg	Luxembourg	1988
Netherlands	Amsterdam	1986
Poland		**1993**
Portugal		**1993**
Romania		**1994**
Spain		**1994**
Sweden	Stockholm	1980
Switzerland	Zurich	1978
United Kingdom	**London**	**1994**
	Glasgow	

Data from the programme is reported occasionally in City Air Quality Trends reports (UNEP/WHO, 1992, 1993, 1995). As an example, the data for Madrid, as reported by UNEP/GEMS (1993) is reproduced in Figures 3.7 and 3.8.

At present, efforts are made by the GEMS/AIR secretariat in Geneva to revitalise the programme.

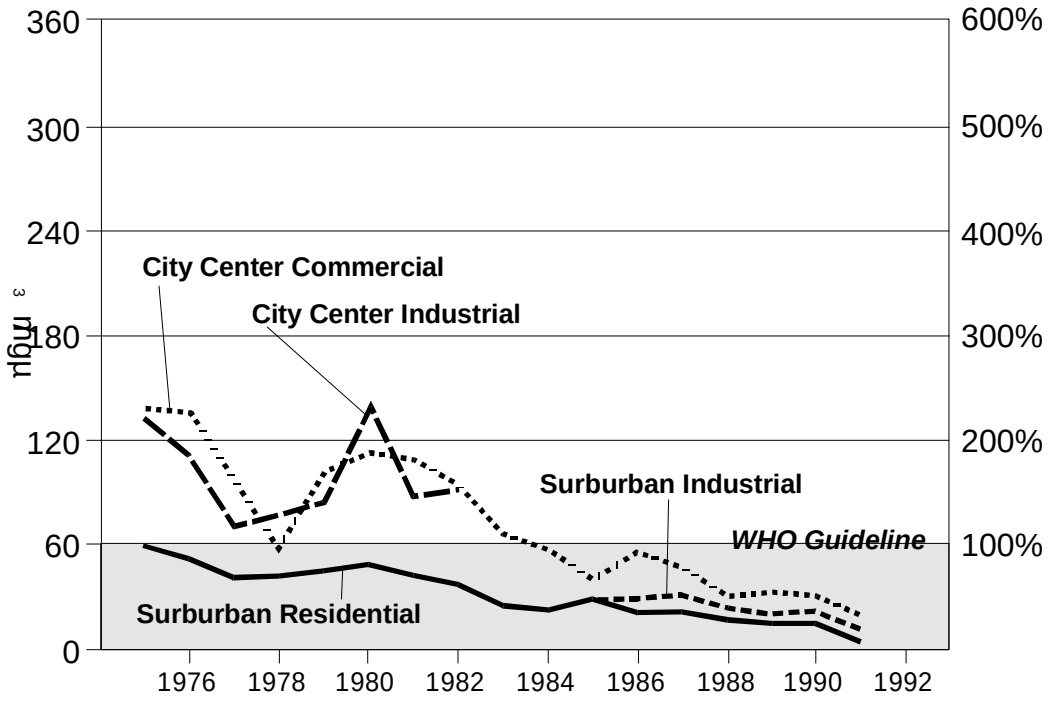


Figure 3.7: Annual mean SO_2, Madrid.

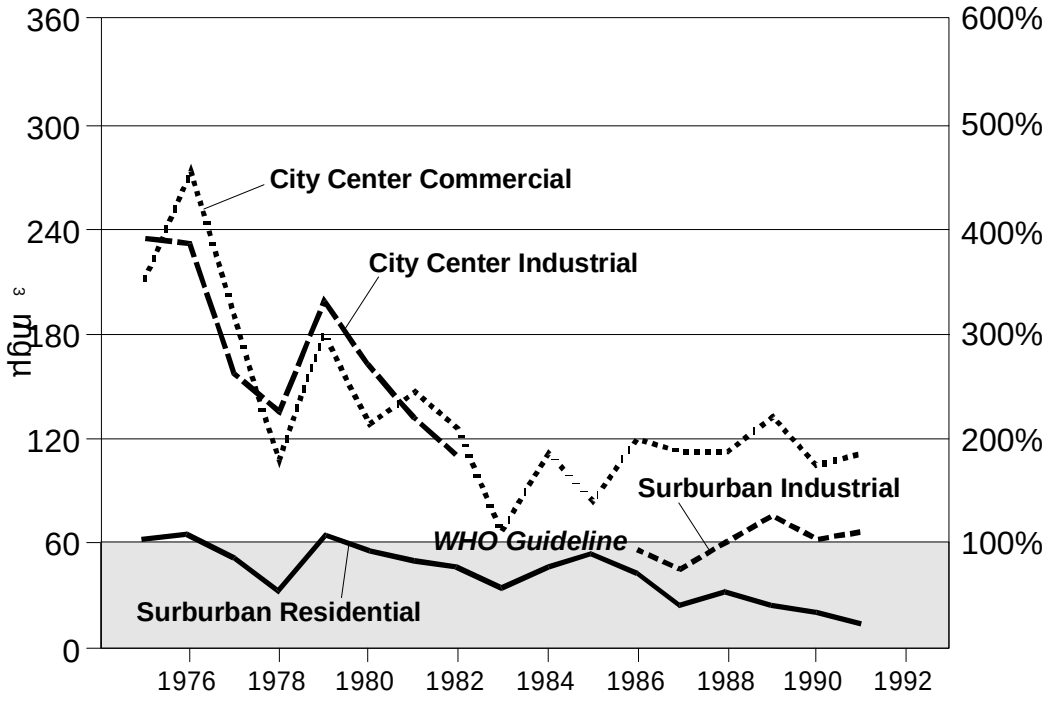


Figure 3.8: Annual mean SPM (smoke), Madrid.

4. The air quality monitoring situation in Europe - state and trends

In reading of the following summary of European-wide air quality monitoring, one should be reminded that **only networks and sites in routine long-term operation have been included in this report**. This is of important especially when the inclusion of new methods and/or compounds is discussed. For instance, PM_{10} may be measured in many countries at test sites or for scientific purposes, and only if it is specifically included as part of long-term monitoring, it is included in the summary here. The same is the case for PAH and probably other compounds.

Summaries are given on the following items:

- Coverage (temporal, spatial, compounds, site categories)
- Methods evaluation
- Data availability
- Reporting
- Network description reports
- Meteorological and emissions data
- Use of models in the AQ assessment
- Shortcomings and gaps
- Near future trends

4.1 State of air quality monitoring in Europe

4.1.1 Coverage

Temporal

Most countries operate the networks the entire year. Exceptions are Norway and Sweden, where the monitoring is concentrated to the six winter months, which have the highest concentrations. For regional sites in Sweden, O_3 and NO_2 are monitored only in the six summer months, except for the 6 EMEP stations, which are monitored all the year.

It seems like, with a few exceptions, especially in East European countries, the monitoring/sampling covers all days/hours.

Spatial (see Table 4.1)

Most countries have a substantial number of monitoring sites in operation. The networks in each state may be national, regional or local in area coverage, and the organisation of monitoring responsibilities between national, regional or local authorities differs between states.

The largest states in EU have the most sites. Examples: France (close to 900 sites), Germany (more than 500 sites), Spain (about 1000 sites), and UK (about 80 active sampling and over 1100 passive sampling sites).

On the other end of the scale, Albania has 23 urban sites, Greece has 32 sites (31 urban), Croatia has 41 sites (40 urban), Norway has 45 sites (6 urban), Denmark 35 sites (18 urban), Hungary 39 urban sites, Estonia 18 sites (16 urban/local).

The number of sites per country is shown on maps in Figures 4.1 and 4.2, for local/industrial and regional air pollution respectively.

Totally, the number of air pollution monitoring sites in Europe is very large. For the 29 countries with data available to us, there are close to 5,000 urban/local sites, and more than 800 regional sites.

The number of sites and networks in operation, and the requirements to monitoring which are set for each of the states, indicate a substantial spatial coverage, in terms of coverage of the areas which have potential air pollution problems. From the information available for this report, the shortcomings or gaps in the coverage, in terms of complete mapping of areas of high concentrations and exceedances, cannot be judged in detail. Such an evaluation must be carried out by each state.

Compounds (see Table 4.2)

Urban/local monitoring

The monitoring in **EU member states** cover the Compound Specific Directives compounds well (CSD: SO_2, NO_2, TSP/BS, Pb, O_3), with the exception of Pb for a number of states.

Regarding the additional compounds mentioned in the draft Framework Directive (FWD), most EU member states measure CO routinely and 6 member states also include heavy metals in their program. Regarding further compounds included in the EoI draft directive, 8 member states measure VOC. PAH and H_2S is also measured routinely in a few states (the Netherlands and the UK).

For the **other countries**, CSD compounds are also covered well, but local O_3 is not measured in 3 states (Albania, Bulgaria, Croatia) and Pb is not measured in 8 states (see Table 4.2). Regarding FWD additional components, CO is measured routinely in 10 of the other states, and heavy metals in 2 of them. Of EoI additional compounds, VOC or benzene/BTX is measured in 5 of those states, H_2S in 3 of them, and PAH in one.

It is realised that the gaps in compound coverage may be due to each country's evaluation of the need to include certain compounds, based on an evaluation of the actual pollution levels, e.g. from previous studies, as well as due to restricted resources, lack of analytical capabilities, or other.

Regional monitoring

The sites have been classified according to compounds, in this way: sulphur and nitrogen compounds in air (SO_2 , NO_2 , major ions in aerosol), deposition, ozone, ozone precursors.

All states monitor S and N compounds in air and deposition. Regional ozone is monitored in all states except Greece, Liechtenstein, Iceland, Bulgaria, Croatia, Hungary, Poland. O_3 precursors are measured at one or a few sites in Austria, France, Germany, Luxembourg, the Netherlands, Sweden, Switzerland and UK. (For Belgium, info on this is lacking.)

Site categories (see Table 4.1)

The sites have been, to the extent possible, categorised as urban general, traffic hot-spot, industrial hot-spot (urban or rural), regional.

All categories are represented in most countries for which the distribution is known from the information available. In most states, most sites are urban general sites. Traffic and industrial hot-spots are less well represented, but in the 19 countries where a full classification of the sites is known, there are the following total number of hot-spot sites:

Traffic	:	754
Urban industrial	:	130
Rural industrial	:	93

Table 4.1 Spatial coverage, European AQ monitoring.

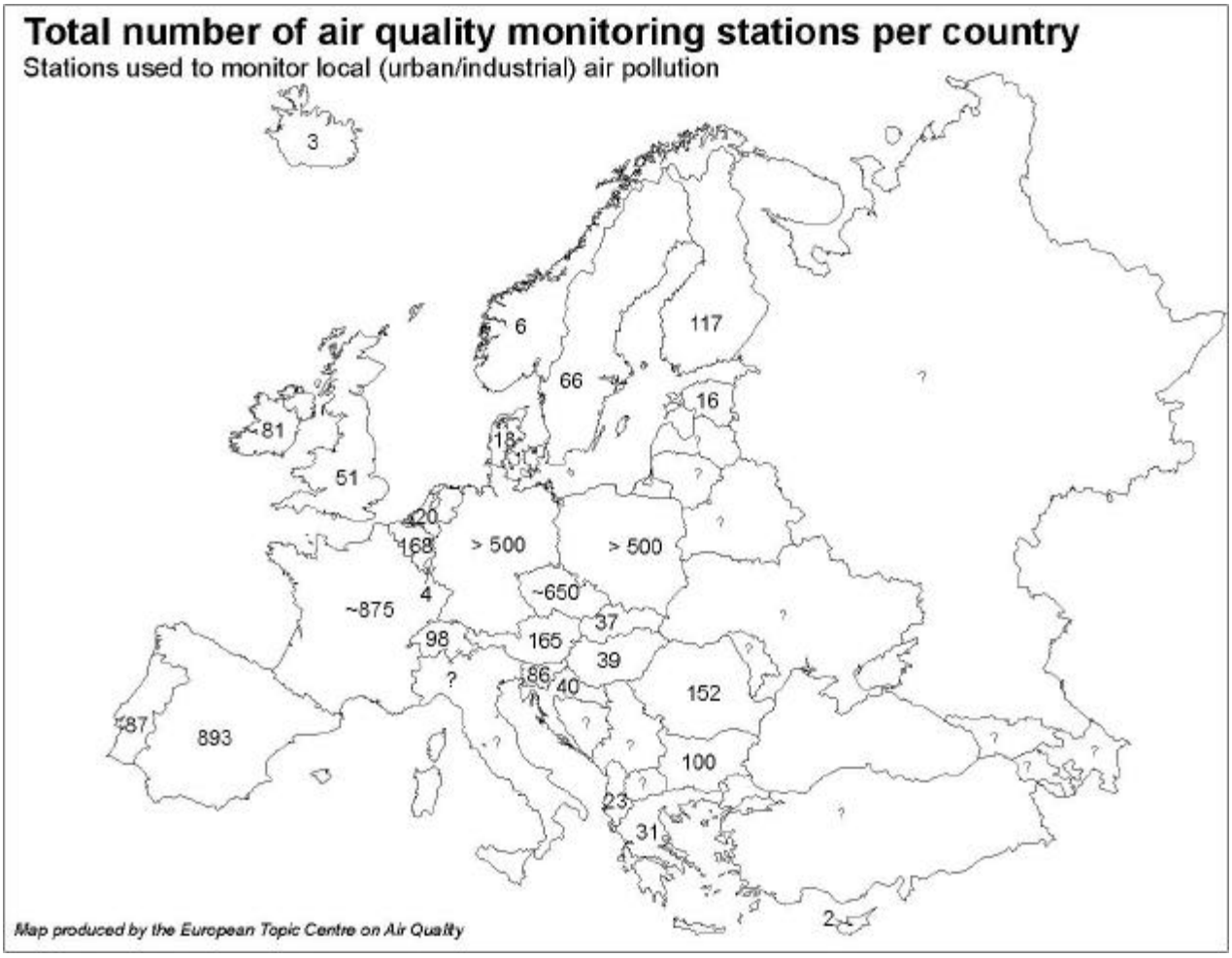
	LOCAL						REGIONAL			
	No. of sites	No. of cities/towns	Site class distribution				No. of sites	SO_2 +	Dep.	O_3
			UG	UT	UI	RI				
Austria	165	10	100	30	20	15	55	55	35	55
Belgium	168	60	125		30	13	25			
Denmark	18	3	7	8	3	0	17	6	17	3
Finland	120	30	71	18	28	3	22	8	7	9
France	875		875				21	17		21
Germany	467		232	156	79		74	65[8]		57[8]
Greece	31	11	22	2	7	0	1	1	1	0
Ireland	81	15	45	25	10	1	12	7		5
Italy	129[3]	41	129				3[4]	3	3	2
Luxembourg	4	1	1	2	1	0	2	1	0	1
the Netherlands	20	9	7	13	0	0	36	30	14	26
Portugal	80	5	6	15	6	53	13	12	3	3
Spain	893		288	438	167		190			>7
Sweden	66	45	63	3			49	12	36	5
U.K.	51[5]	34	45	2		4	>38	38	32	15
Iceland	3	2	1	1	0	1	1	1		
Liechtenstein	1	1	1	0	0	0				
Norway	6	6	6	0	0	0	39	12	34	15
Albania	23	11	23							
Bulgaria	100		100							
Croatia	62	8	62				1	1	0	0
Cyprus	2	1	0	2	0	0	1	1	1	1
Czech Republic	650[1]									
Estonia	16	9	8	2	6		2	2	2	2
Hungary	39		39				2	2	2	
Poland	>540	[7]	>500		33		11			
Romania	152		152				138	4	137[2]	4
Slovakia	37	17	14	6	10		7	7	7	4
Slovenia	86		86				4			
Switzerland	98[6]		55	31	12		54			
TOTAL	>4983						>818			

1) Total for urban and regional. Site classification not known.
2) All stations measure pH, conductivity and acidity/alkalinity. 14 sites measure major ions.
3) Not complete.
4) Only EMEP sites
5) Plus 1100 passive NO_2 sampling sites
6) Plus 12 passive SO_2 and 102 passive NO_2 sites.
7) All cities with >20,000 inhabitants.
8) The number of sites may not be quite correct.

Table 4.2: Compound coverage, European AQ monitoring.

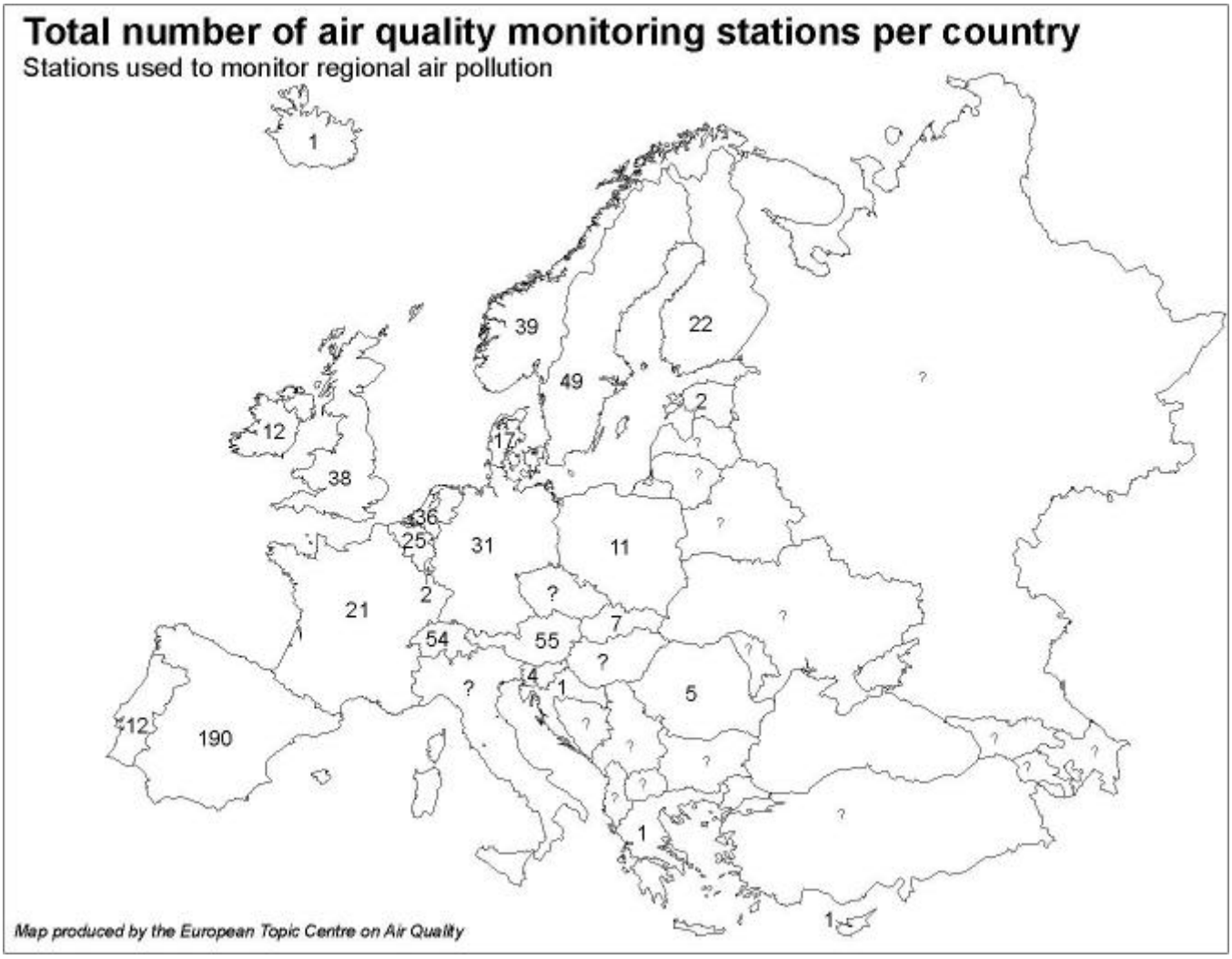
	LOCAL			REGIONAL			
	CSD[1]	FWD	EoI	SO_2 +	Dep.	O_3	O_3 precursor
Austria	x	CO	VOC, H_2S	x	x	x	x
Belgium	x	CO	VOC	x	x	x	
Denmark	x	CO, Metals		x	x	x	
Finland	x	CO, Metals		x	x	x	
France	x	CO	VOC	x	x	x	x
Germany	x	CO	VOC	x	x	x	x
Greece	x	CO		x	x		
Italy	x	CO		x	x	x	
Ireland	x			x		x	
Luxembourg	x	CO, Metals	VOC	x		x	x
the Netherlands	x	CO, Metals	PAH	x	x	x	x
Portugal	x (- Pb)	CO		x	x	x	
Spain	x	CO, Metals	VOC, H_2S	x	x	x	
Sweden	x	Metals	VOC	x	x	x	x
U.K.	x	CO, Metals	VOC, PAH	x	x	x	x
Iceland	x	CO		x	x		
Liechtenstein	x (- Pb)	CO					
Norway	x (- SO_2, Pb)		BTX	x	x	x	
Albania	x (- O_3, Pb)			x			
Bulgaria	x (- O_3)	CO, As	H_2S	x			
Croatia	x(- O_3 , Pb)		H_2S, PAH	x	x		
Cyprus	x	CO		x	x	x	
Czech Republic	x	AD, Metals		x	x	x	
Estonia	x (- Pb)	CO	H_2S, BTX	x	x		
Hungary	x (- Pb)	CO	VOC	x			
Poland	x	CO, Metals		x			
Romania	x (- Pb, SPM)	CO	VOC	x	x	x	
Slovakia	x	CO		x	x	x	
Slovenia	x	CO		x	x	x	
Switzerland	x (- Pb)	CO	VOC	x	x	x	x

1) x means that all 5 compounds (SO_2, NO_2, BS/TSP, Pb, O_3) are measured.



Czech Republic: The number gives the sum of local and regional monitoring sites.

Figure 4.1: Number of sites per country for the monitoring of urban/local/industrial air pollution.



Czech Republic: Sum of local and regional sites. Romania: Stations with only precipitation chem. (137) not included in the number.

Figure 4.2: Number of sites per country for the monitoring of regional air pollution (incl. wet deposition).

4.1.2 Methods evaluation

Methods have been roughly classified according to the following scheme:

- Standard techniques, conforming to the requirements set in EU directives, or considered equivalent to those.

  State-of-the-art, or advanced techniques.
  These include e.g. the DOAS technique, and diffusion tubes for NO_2 , BTX etc.

- Non-standard techniques.
  Techniques not conforming to the requirements of the directives, or not considered equivalent, in terms of required accuracy and specificity.

All countries utilise standard or advanced/state-of-the-art methods for some or all of the compounds measured. Many countries in Eastern Europe still utilise non-standard methods for some of the compounds (see Chapter 3 and Appendix A for details).

Table 4.3 shows which countries have, to our knowledge, introduced in the monitoring networks the following new parameters/techniques that are candidates for being introduced soon in directives or as reference methods:

- PM_{10}, either manual sampling or monitors
- Benzene/BTX, active methods, either manually by DOAS, or other (UK, see below).
- Passive samplers for SO_2 , NO_2 , BTX etc.

Regarding QA/QC procedures, no specific information to classify these has yet been collected.

Table 4.3: New compounds/techniques.

	PM_{10}		Benzene/BTX		Passive samplers	
	Hourly	Integrated	Hourly	Integrated	NO_2	BTX
Austria			x(½)		x[1)]	x[1)]
Belgium	x					
Finland	x	x	x			
France	x					
Germany	x					
Greece	x					
the Netherlands	x					
Portugal						
Spain	x					
Sweden	x		x			x
U.K.	x		x[2)]		x	
Iceland	x	x				
Norway	x	x	x			x
Cyprus	x					
Czech Republic	x					
Estonia			x			
Poland	x					
Slovakia	x					
Slovenia	x					
Switzerland	x					

(½) : half-hourly from 1995.
1) : Passive sampling during limited monitoring campaigns.
2) : UK has on-line, compound-specific VOC monitoring at 9 sites.

4.1.3 Data availability

One of the main features of modern monitoring networks, besides measuring compounds with sufficient accuracy, specificity and coverage, is the ability to make the data available to users and the public soon after the measurement has taken place.

For manual methods requiring analysis in a laboratory after sampling, a typical delay time before quality controlled (or accredited) data are available has normally been at least 1-2 months. Often the delay is much longer, especially if the demand for a short delay time is not made specific.

With the more widespread use of monitors, and as monitors cover more compounds, the possibility for a widespread network giving data daily, or even with shorter delay (hourly, or near-real-time), is increasing.

It is important to differentiate between the cases where data are available in a data base to the responsible agency only, for use internally or in monitoring forecasting

systems, and the cases where the data are accessible externally, e.g. for national authorities, to the EEA, to the media etc.

Table 4.4 gives an overview of the specific information we received on the data availability for each country.

According to our information, the following countries can make data from monitors available externally, in near-real-time (one-a few hours delay): Austria, Denmark, the Netherlands, U.K., Norway, Cyprus.

Our information is not complete, and many countries are missing from this list, because specific information was not given. Thus, Table 4.4 should be used to give examples of how soon countries make AQ data available. Typically, validated data are available 1-6 months after measurement, varying between countries.

Table 4.4: Data availability (excl. O_3 warning).

	LOCAL				REGIONAL			
	Non-validated data		Validated data		Non-validated data		Validated data	
	1h	24h	1h	24h	1h	24h	1h	24h
Austria	nrt-a		1-a	1-a	nrt-a		1-a	1-a
Belgium								
Denmark	nrt-na	1-na	4-na	4-na	nrt-na	1-na	4-na	4-na
Finland			1-	1-				
France			9-				9-	
Greece			1-2-				1-2	
Luxembourg			2-				2	
the Netherlands	nrt-a		1.5-a	3-a	nrt-a		1.5-a	3-a
U.K.	nrt-a			3-6-a	nrt-a		3-6-a	
Norway	nrt-a		1-a	2-a	nrt-a	2-na	6-8-	
Cyprus	nrt-a		2-a		nrt-a		2-a	
Hungary			3-					
Romania			1-2-					
Slovakia	na		1-a				2-3	
Slovenia	daily-a							

nrt : near-real-time
a : accessible for external users
na : not accessible for external users
1-a : available after 1 month delay

4.1.4 Reporting

The information collected on when data reports or summarising reports (e.g. annual reports) are available, is summarised in Table 4.5. Reporting of ozone data to the public is also included here, since there is a special requirement to this in the ozone directive.

Table 4.5: Reporting.

	O_3	Other		Network description report
		Local	Regional	
Austria	Daily or several times a day	February	February	x
Finland		April	November	
France				
Greece		April-May	April-May	
Luxembourg		February	February	
the Netherlands	Twice a day	June	June	x
Sweden		September		
Portugal				
U.K.	Twice a day	September		
Liechtenstein	Included in Swiss reports			
Norway			October-December	
Cyprus		December		
Hungary		December		
Romania		June-December	June-December	
Slovakia		August	August	
Slovenia		April-May		
Switzerland		July-August	July-August	

Annual reports are available after 2-12 months delay.

Also here, the available information is far from complete. Countries like France and German "Länder", the Czech Republic and others certainly publish annual reports within the year after the year in question, but specific information when (which month) was not given.

The examples of how countries report and visualise air quality data, shown in the annexes to the country reports in Appendix A, show how widely this differs. **One of the more important observations is that many countries do not give, in their reports, the statistical AQ parameters that are required, by the EU directives. This is one of the major difficulties in comparing air quality across Europe.**

4.1.5 Network description

There is a column for this in Tables 3.2 and 3.3. Network description reports are at presently available to us only from Austria, the Netherlands and Spain. For many other countries, a more brief description of sites are included in the annual reports.

4.1.6 Use of models in the air quality assessment

The following countries provided information about their use of dispersion and/or other models as part of their routine surveillance and assessment of air quality: Finland, the Netherlands, Norway, Sweden, U.K (Our information about this point is so far incomplete).

4.2 Shortcomings and gaps

This report has described the very substantial effort in all the 30 European countries included, to monitor their air quality in urban and other polluted areas, as well as in regional background areas. Shortcomings or gaps in the effort, evaluated relative to requirements in EU directives, can still be detected in some cases. It must be remembered that the information available to us is not complete in all respects. Thus, we will only identify clearly visible gaps, when we are sure our information is complete.

Spatial monitoring coverage

The spatial coverage is substantial in all countries. Gaps in coverage must be evaluated by each country themselves.

Compound average

Some countries do not measure Pb and O_3 routinely in the networks (Table 4.2).

Temporal coverage

In Norway and Sweden, local air quality (except for ozone) is only measured during the 6 winter months.

In some Eastern European countries, all days of the year may not be covered by measurements in some networks. In Albania, for example, measurements are carried out only 7-10 days per month.

Site coverage

In this report, the site classification urban background, traffic hot-spot, industrial hot-spot (urban or rural), and regional has been used. In many countries, all these classes are well represented, but in some countries, hot-spot monitoring sites are lacking.

Data availability

Most countries from which we have specific information on this topic, have validated data available in their own data bases within 6 months after monitoring measurements.

Thus, there should be no problem in principle in making the data available to the EEA within 6 months into the year after.

Reporting

It is not clear that annual reports are available from all networks/countries within one year after. Naturally the contents of the network/natural reports differ substantially between countries, and even between networks/regions in each country.

All countries/networks do not report parameters/statistics as required by the EU directives. This makes European air quality summaries and comparison incomplete.

4.3 Near-future trends

For some countries, information was given on processes to evaluate and develop the networks.

In **Austria**, an evaluation is underway which probably will result in a reduced number of CO sites (and to a minor extent SO_2, NO_2 and SPM sites), some relocation of sites, and establishing Pb and benzene networks.

In **France**, the regional networks are being connected to the ADEME, the national monitoring centre, and data from those connected networks will be available in near-real time.

In the **UK**, the Automated Urban Network is being substantially extended, and an external evaluation of the monitoring efforts is underway.

In **Norway**, the urban coverage is being improved, and an on-line monitoring and modelling system (AirQUIS) is being established in some cities, providing ability to model urban-scale air quality in near-real time.

In **Croatia**, the network is under further development, and a central information system is contemplated.

There is also a trend towards including more compounds routinely in the network. Such compounds are PM_{10} and benzene (or BTEX), for which new EU directives are underway. However, the PM_{10} monitoring going on at present is not very extensive.

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Text for the cover back page :

The European Topic Centre on Air Quality (ETC-AQ) is under contract to EEA inter alia to develop a general approach to air quality assessment on a European scale. Within this activity it is intended

- to maintain and develop expertise and exchange information with National Focal Points and National Reference Centres for Air Quality and hence develop the air quality aspects elements of the European Environment Information and Observation Network (EIONET),
- to assist EEA in compiling periodical assessment reports.

To meet these objectives, three initial tasks were identified:

MA1-1 Collect information on requirements for monitoring information and discuss/review with NRCs/NFCs/DGXI/EEA

MA1-2 Report on state of situation - problems and trends

MA1-3 Report on recommendation for approach to be adopted at the European level

The present report is the first result of the task MA1-2, 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 EIONET.

The air quality monitoring practice in Europe is summarised and described in detail based upon information collected in 1994 from monitoring networks within 30 European countries. Also the monitoring activities in 8 international programmes are summarised.

The coverage of air quality monitoring in Europe, in terms of time, space, compounds and site categories is substantial for most of the reporting countries. There are a total of close to 5,000 sites for urban/local monitoring and more than 750 sites for regional monitoring. Hot-spot sites (traffic, industry) is less well represented than are general urban background sites. In a number of countries, lead monitoring seems no longer to be well represented and in some countries ozone is not monitored. Ozone precursors are monitored at one or a few regional sites in 7 countries only.