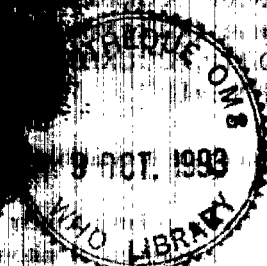


G E M S / A Q A

Global Environment Monitoring System

A Global Programme for Urban Air Quality Monitoring and Assessment

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For bibliographic and reference purposes this publication should be referred to as:

UNEP/WHO 1993
GEMS/AIR - A Global Programme for
Urban Air Quality Monitoring and Assessment
WHO/PEP 93.7, UNEP/GEMS/93.A.1
UNEP Nairobi

This brochure is available through:

United Nations Environment Programme
Global Environment Monitoring System Programme Activity Centre
P. O. Box 30552, Nairobi, Kenya

World Health Organization
Prevention of Environmental Pollution
CH-1211 Geneva 27, Switzerland

Printed by: Majestic Printing Works Ltd, P.O. Box 42466, Nairobi, Kenya

Introduction

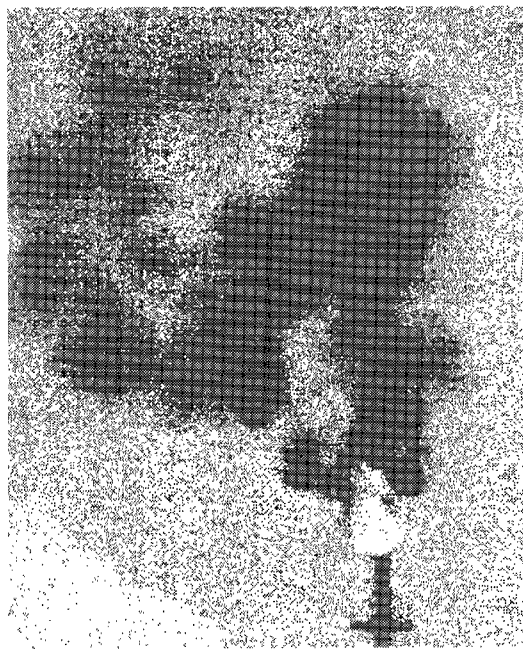
The purpose of this brochure is to describe the response of the urban air pollution monitoring and assessment programme GEMS/AIR to the implementation of Agenda-21, the action plan for sustainable development adopted by the 1992 United Nations Conference for Environment and Development (UNCED); to increase the number of countries adopting the programme; and to call upon bilateral and international funding organisations to support it.



Urban Air Pollution - The Problem

Urban areas have high concentrations of man-made air pollution sources, such as power generation, motor vehicle traffic, residential heating, and industry. Urban air pollution not only poses a threat to human health and the urban environment, it also makes a significant contribution to regional and global atmospheric pollution problems. There is a marked increase in urban population world-wide which will lead both to an increase in the emissions of pollutants, and to an increase in the number of people exposed directly to the effects of these

pollutants. By the year 2000, close to 6 billion people will be living on this planet, and about 45 % of them are expected to be in urban areas. The threat to human health and the environment resulting from urban air pollution is thus a world-wide problem and an issue of global concern.



In order to assess the potential impact of air pollutants on human health and the environment, and to develop effective air pollution management measures, it is necessary to have a reliable knowledge of the sources, levels and distribution of air pollutants in an area. 'Smog' which forms from some air pollutants and certain weather conditions

is a visible sign of poor air quality in a city. However, most of the common air pollutants are invisible and their presence must be measured with appropriate equipment. Thus air quality monitoring programmes are of fundamental importance if the extent and sources of the pollution problems are to be identified, and effective controls devised and their implementation assessed.

GEMS/AIR: A historical perspective 1973-1992

GEMS/AIR is an urban air pollution monitoring and assessment programme, which evolved from a World Health Organization (WHO) urban air quality monitoring pilot project, that started in 1973. Since 1975, WHO and the United Nations Environment Programme (UNEP) have jointly operated the programme as a component of the United Nations system-wide Global Environment Monitoring System (GEMS).

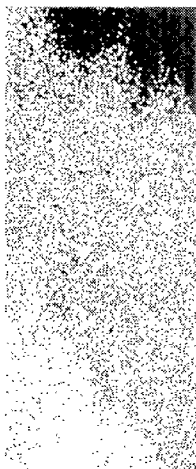
GEMS is a component of the UN Earthwatch system.

The original objectives of GEMS/AIR were:

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

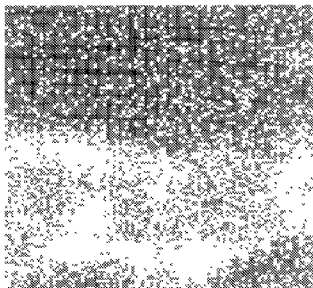
GEMS/AIR Achievements

- Establishment of a global network of 270 monitoring sites in 86 cities in 45 countries
- Support of monitoring and assessment operations through training, expert advice, and logistic support
- Support of quality assurance procedures through auditing of city monitoring networks
- Development and publication of methodology handbooks
- Publication of global assessments of monitoring data

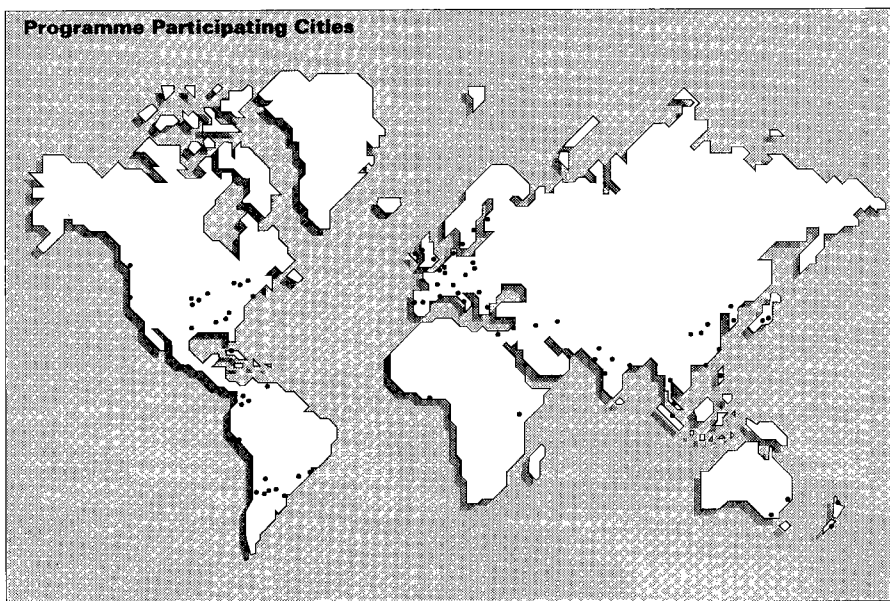


The GEMS/AIR Network

Since its beginning in 1973, the GEMS/AIR network has included some 270 monitoring sites in 86 cities in 45 countries. Monitoring stations are run by the national or city authorities who voluntarily contribute their data to the GEMS/AIR global data base. The cities represent a wide range of climatic and socio-economic conditions, as well as different levels of development and air pollution control capabilities. GEMS/AIR is the only global programme which provides long-term air pollution monitoring data for cities in industrialised as well as in developing countries. Thus the programme enables the production of assessments on the levels and trends of urban air pollution world-wide.



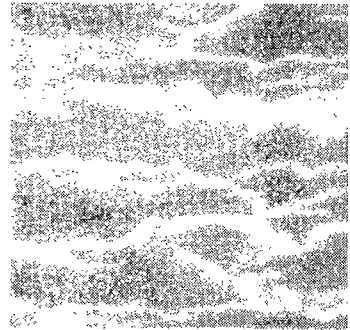
Programme Participating Cities



GEMS/AIR and UNCED

The 1992 United Nations Conference on Environment and Development (UNCED) has identified environmental degradation in cities as one of the areas which requires immediate attention. Agenda-21, the sustainable development action plan for the 21st century, highlights in several chapters the importance of urban air pollution and calls upon national and local governments and the international community to increase their efforts towards obtaining reliable and accessible data and information on pollutant concentrations, sources and effects. More specifically, Agenda-21 recommends:

- development of appropriate urban air pollution management capacities in large cities and the establishment of adequate environmental monitoring capacities for surveillance of environmental quality and the health status of populations (chapter 6, protection of human health).
- improved access to environmentally sound technologies for developing countries, including the provision of training and the development of extensive international information networks (chapter 34, transfer of technology and capacity building).
- development and expansion of Earthwatch, the UN-system wide monitoring and assessment programme, of which GEMS/AIR is a component (chapter 38, international institutional arrangements).
- improvement of data collection and of methods of data assessment so that national and international decisions can be based on sound information; and strengthening of UN data collecting activities, particularly of the Global Environment Monitoring System (chapter 40, information for decision making).



GEMS/AIR: The future perspective 1993-2000

GEMS/AIR Phase 2 (1993-2000) Programme Activity Areas

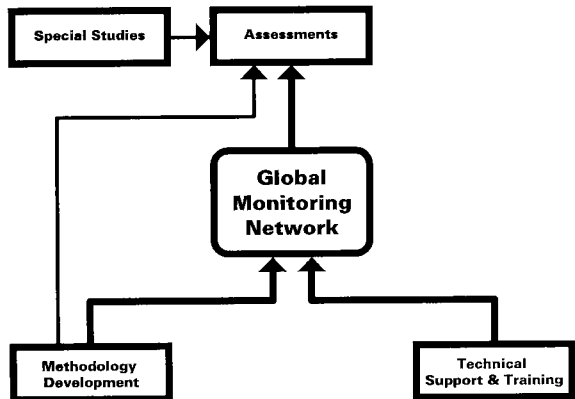
- 1 Coordination of the global monitoring network
- 2 Development of appropriate methodologies
- 3 Preparation of assessments
- 4 Provision of technical support & training
- 5 Initiation of special studies

In recognition of the increasing challenges faced by the escalating urbanisation all over the world, an outline for an expanded GEMS/AIR programme (GEMS/AIR Phase 2) was prepared for the period 1993 - 2000. The overall objective of the programme is to:

- provide the comprehensive information needed for rational air quality management.

Within this objective, the following sub-objectives were defined:

- provide an international framework for coordinated and valid monitoring of urban air quality, effective data management, and reliable information dissemination;
- develop methodologies, adapted to the specific needs of the participating countries, required for the comprehensive monitoring and assessment of urban air quality;
- produce comprehensive assessments which include levels and trends of urban air quality, pollution sources, and options for abatement, as well as of potential health and environmental effects;
- strengthen urban air quality monitoring networks and assessment capabilities in developing countries.



Activity Area 1: Coordination of the Global Network

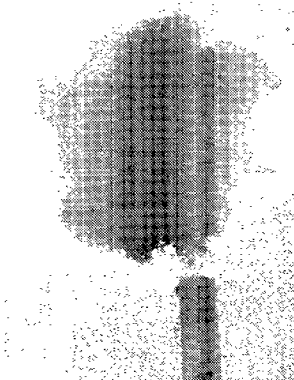
The operation of the global urban air pollution monitoring stations by the participating countries is the heart of the GEMS/AIR programme. Since its beginning in 1973, a network has linked cities together and enabled the transfer and sharing of knowledge and experience. It provides an effective framework for coordinated, valid and comparable monitoring of urban air quality, effective data management and utilisation and

reliable dissemination of information. Network participants provide selected urban air pollution monitoring data and descriptive additional information to the global database or GEMS/AIR monitoring and assessment centres. Thus the programme enables data and information compilation on a global scale and the production of assessments on the occurrences of urban air pollution world-wide.

In GEMS/AIR Phase 2, this network will be expanded to many more major cities in all parts of the world. The aim is to have 100 participating cities by the end of the decade, including 50 major cities with a population of more than 3 million. The scope of the programme will be widened to include, in addition to sulphur dioxide (SO₂) and particulate matter (SPM), data on all common air pollutants, such as carbon monoxide (CO), nitrogen oxides (NO, NO₂), ozone (O₃), and lead (Pb).

Coordination of the Global Network

- Routine collection of monitoring data from participating cities
- Collection of emission inventories and supporting data
- Provision of network audits, and oversight of quality assurance
- Operation of global data bank
- Evaluation of monitoring data, and preparation of data reports
- Expansion of the programme in terms of cities and pollutants



Activity Area 2: Development of Appropriate Methodologies

Development of Appropriate Methodologies

- Production of methodology handbooks on network design, sampling and analytical methods, and assessment techniques
- Development of support tools for emission inventories and air pollution management
- Development of monitoring data transfer software
- Establishment of global guidelines on urban air quality

The development of appropriate methodologies supports the collection of air quality data by the participating countries. Suitable methodologies are identified and recommended to participants, utilising existing knowledge and expertise. Before publication, handbooks and technical reviews are discussed in expert workshops so that international consensus can be assured.

In GEMS/AIR Phase 2, development of methodologies will focus on the further harmonisation of network design, sampling and analytical methods, and assessment procedures, so that data from the various cities and networks can be better compared. It is the aim of the programme to continue the production of methodology review handbooks and software tools, covering the whole urban air monitoring field from network design to data interpretation and assessment, as well as air pollution management tools.



Activity Area 3: Preparation of Assessments

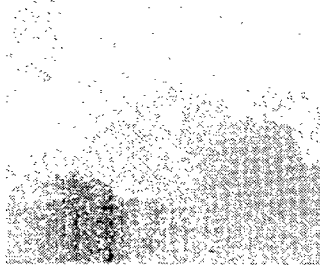
Assessments are one of the major outputs of the programme and provide a consensus view on air pollution trends, issues, and options for management purposes. They are based upon the information collected through the GEMS/AIR network and on other information available in the scientific literature and technical reports. GEMS/AIR

assessments evaluate the reliability of data and interpret air quality data and additional information in terms of potential health and environmental effects. Global and topic-specific assessments are supplemented by summary data reports, e.g. the City Air Quality Trends series.

In GEMS/AIR Phase 2, global synoptic assessments will compile GEMS/AIR network data and other available information, examining the data in terms of the established WHO guidelines, and assessing the risks for human health and sensitive ecosystems. Topic-specific assessments will focus on problems of specific interest, and on regional issues. City-specific assessments will cover pollutant emissions and sources, meteorological and topographical factors affecting pollutant dispersion, ambient pollutant concentrations in various parts of the city, the resulting risk for the population and the environment, and options for pollution management. Assessment production will be coordinated by the GEMS Monitoring and Assessment Research Centre (MARC).

Preparation of Assessments

- Global assessment on urban air pollution levels and trends
- Topic-specific assessments in areas of interest
- City-specific assessments for selected cities
- Annual reports of GEMS/AIR monitoring data
- Summary report of air pollution concentrations and trends in GEMS/AIR



Activity Area 4: Provision of Technical Support & Training

Provision of Technical Support & Training

- Support of regional training courses and expert advice on air pollution monitoring, assessment and management
- Training in use of rapid assessment methods for developing emission inventories
- Strengthening of regional audit teams and support centres
- Support of technology transfer in the field of air pollution monitoring and management methods

Technical support and specific training allows cities in less developed countries to monitor, assess, and manage their air pollution properly. They can then fully participate in and take advantage of the GEMS/AIR programme. This programme element will continue to be instrumental in strengthening monitoring and assessment capabilities in participating cities. It further provides a mechanism to enable developed and devel-

oping countries to share experience. While capacity building in such cities certainly exceeds the financial and technical capabilities of the GEMS/AIR programme, the programme will continue to serve as an effective framework for cost-effective technical support and technology transfer.

In GEMS/AIR Phase 2, training workshops will be organised for GEMS/AIR participants in Africa, Asia, and Latin America, covering all aspects of air pollution monitoring, emission inventories, assessment, and management. Furthermore, the regional centres for network auditing and technical support which were established during the first phase of the programme will be strengthened.



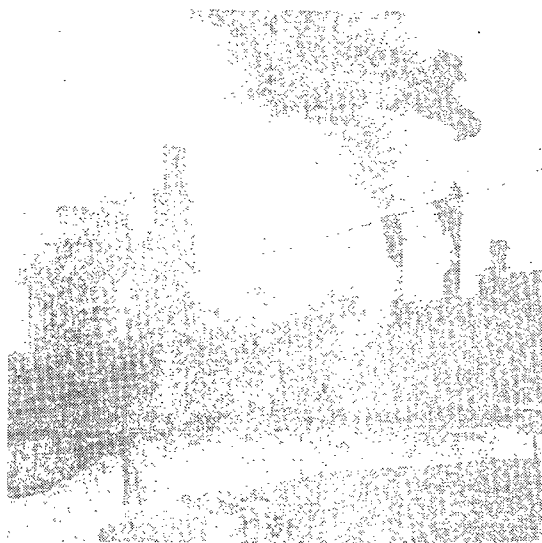
Activity Area 5: Initiation of Special Studies

The initiation of special studies is a new programme element. Special studies will allow GEMS/AIR to rapidly examine emerging issues or new requirements and to assist countries to meet them. The results of these studies will improve the understanding of key global, regional and local air pollution issues. Implementation of the studies will depend on the participating cities and the availability of extra resources.

In GEMS/AIR Phase 2, the aim of this activity area is to complete five special studies by the end of the decade. Various topics have already been proposed covering a wide range of issues. New topics may be proposed by programme participants.

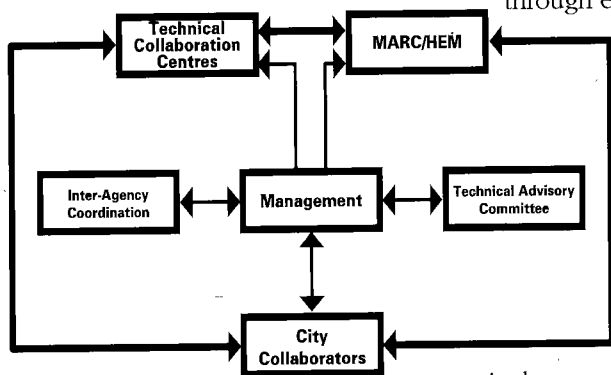
Initiation of Special Studies (Examples)

- Evaluation of the effectiveness of air pollution management programmes
- Quantification of ambient air pollution contribution to pollutant exposure
- Contribution of urban SO₂ and NO₂ emissions to regional acid depositions
- Contribution of urban precursor emissions to photochemical smog formation in down-wind urban and rural areas
- Global survey of NO₂ and O₃ levels in urban areas



GEMS/AIR Programme Structure

GEMS/AIR is based on the voluntary collaboration of the participating cities. The local programme collaborators implement the programme at the city level. The programme operation is supported and coordinated by World Health Organization (WHO) and the United Nations Environment Programme (UNEP). WHO supports the programme through the expertise of its Prevention of Environmental Pollution (PEP) unit in Geneva and its Collaborating Centres, and provides global communication facilities through the well established system of WHO regional offices. UNEP supports the programme through expertise at the Global Environment Monitoring System Programme Activity Centre (GEMS/PAC) in Nairobi, the GEMS Monitoring and Assessment Research Centre (MARC) in London and the Harmonisation of Environmental Measurement (HEM) office in Munich. The programme is also supported by external technical collaborating centres, such as the U.S. Environmental Protection Agency (U.S.EPA) which houses the global data bank, and the institutions providing audit services.



environment Monitoring System Programme Activity Centre (GEMS/PAC) in Nairobi, the GEMS Monitoring and Assessment Research Centre (MARC) in London and the Harmonisation of Environmental Measurement (HEM) office in Munich. The programme is also supported by external technical collaborating centres, such as the U.S. Environmental Protection Agency (U.S.EPA) which houses the global data bank, and the institutions providing audit services.

In GEMS/AIR Phase 2, existing human resources will be complemented with the expertise available in other international programmes and institutions actively working in the field of the urban environment, e.g. the United Nations Development Programme (UNDP), World Bank, United Nations Centre for Human Settlements (UNCHS), the Commission of the European Communities (CEC) etc.

GEMS/AIR Programme

Resources

WHO and UNEP will continue to provide the baseline support to the operation of the programme in terms of manpower and operational funds. This enables the implementation of the core activities. However, additional funding will be needed, if the full potential of the programme is to be realised. In particular, additional funding has to be allocated to help countries develop their air pollution management capabilities, the first step being establishment and operation of air pollution monitoring networks. Training and technical support programmes will be needed to establish the necessary capabilities in major cities in Africa, the Middle East, Asia and Latin America. Extra funds will also be needed to support special studies which provide the basic information necessary to respond to emerging issues and changing conditions.

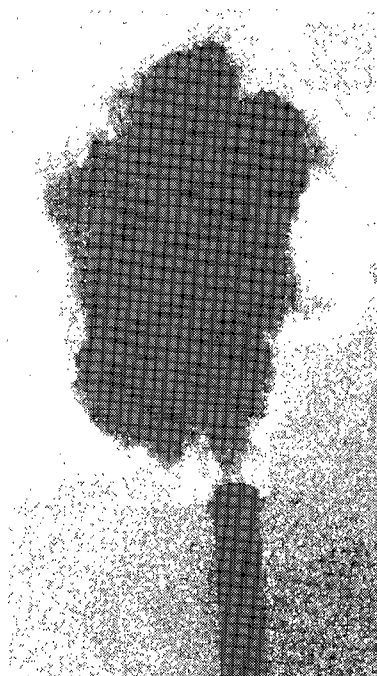
Many cities in the developing world have only limited resources available for management of urban air quality. It is the responsibility of the international community to assist such cities in reducing present and potential risks for human health and the environment. It is in the interest of the international community to strengthen effective urban air pollution management and GEMS/AIR will continue to seek additional financial and other resources from international and national sources, and channel them into effective use.



GEMS/AIR Programme Activities 1993

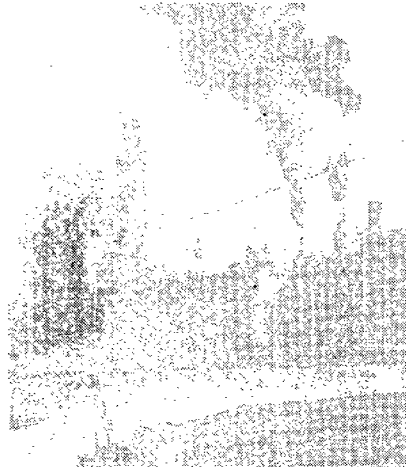
Major activities of 1993 include:

- Expansion of programme to include additional major cities
- Monitoring of an extended set of pollutants
- Initiation of city-specific projects
- Establishment of regional audit teams
- Initiation of an effective network communication system
- Establishment of guidelines for appropriate monitoring methodologies
- Review of monitoring and assessment capabilities in major cities
- Establishment of emission inventory systems for data-poor environments
- Publication of assessment report: Urban Air Pollution in Megacities of the World
- Start of publication series: City Air Quality Trends



GEMS/AIR: A Mechanism for Capacity Building

GEMS/AIR provides an established mechanism for strengthening the capacity of the developing countries in urban air quality management. This is being done through the development, adaptation and dissemination of monitoring and assessment methodology and through data quality assurance which together serve to improve local monitoring. The GEMS/AIR programme also assists national or local authorities in identifying their monitoring equipment needs, and helps them to prepare appropriate funding proposals. Training of national and local staff in urban air quality management with emphasis on air quality monitoring and source inventories is an integral part of the Programme. The participation of countries in the global network provides a continuing opportunity to exchange information and to obtain advice and support from other countries. In summary, GEMS/AIR is a mechanism for building permanent capacities through its many facets of providing training, monitoring equipment, quality assurance and technical information exchange to developing countries.



How to participate in GEMS/AIR...

GEMS/AIR focuses on air pollution in major cities. Any city in a UN member country can join the programme. The participation, however, should be formalised through the national governments.

Cities can join the programme by announcing their interest directly to WHO or UNEP (see addresses on back cover) or alternatively through their national WHO or UNEP focal points. Cities or countries should designate a GEMS/AIR coordinator, ideally the person in charge of the operation of the city monitoring network.

In case of cities already monitoring air pollution routinely, the GEMS/AIR management will send to the coordinator detailed information on the organisation of the global programme, including technical information about monitoring site charac-

terisation and global data management. The GEMS/AIR management and the local coordinator will choose three or four suitable monitoring sites, representing residential, commercial, and industrial influence in the city centre or in suburbs. The sites will be assigned unique international codes for inclusion in the global data base.

Cities which do not monitor air pollution routinely but wish to do so are welcome to join. GEMS/AIR can assist in identifying appropriate monitoring equipment, and in finding appropriate funding sources.

