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UNEP-HEM / WHO / GEMS/AIR Workshops on Sampler Methodologies in Air Quality Monitoring: Availability, Applicability, and QA/QC Implications

I. Gaseous Species

II. Suspended Particulate Matter

7 - 15 September 1992, Munich, Germany

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UNEP-HEM / WHO / GEMS/AIR Workshops on Sampler Methodologies in Air Quality Monitoring: Availability, Applicability, and QA/QC Implications

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CONTENTS

WORKSHOP II: SUSPENDED PARTICULATE MATTER (SPM)

ACKNOWLEDGEMENTS

BMW AG, München, Germany kindly provided financial assistance for travel of selected participants.

1 BACKGROUND

In 1974 the World Health Organisation (WHO) and United Nations Environment Programme (UNEP) jointly established a programme, known as GEMS/AIR, to monitor and assess urban air quality on a global scale. GEMS/AIR is a component of the United Nations Global Environment Monitoring System.

GEMS/AIR is now being re-oriented with the new objective of providing the comprehensive information needed for rational air quality management. The programme will expand its geographical coverage, with an emphasis on developing countries, improve data quality, increase its use of other data (meteorological, traffic statistics, production statistics, etc.), and increase the use of data from other sources. The newly formulated objectives of GEMS/AIR are designed to help cities to obtain and interpret the information needed for developing abatement strategies. Strictly defined and implemented quality assurance and quality control procedures will play a central role in ensuring the comparability and compatibility of data obtained in the network. These proposals were endorsed during a meeting of Government-designated experts held in Geneva in November 1991.

Since reliable data are the basis for rational decisions, one of the objectives of the programme is developing, and providing information about, appropriate methodologies. The Government-designated Expert meeting decided that GEMS/AIR should develop a series of Methodology Review Handbooks to fulfil a part of this need. The series will eventually cover the whole range of methodologies in use in the GEMS/AIR network. The handbooks will provide a review of the state of the art of different methodologies, appropriate and possible applications, and references to more detailed technical literature. One of the main features of this series of handbooks will be an emphasis on QA/QC techniques and specific QA/QC requirements for different methodologies.

The experts agreed that the most pressing need was for information on active and passive sampler methodologies and on the measurement of suspended particulate matter. Following these talks, UNEP-HEM agreed to develop background papers on these topics and call two meetings of experts to review the information and agree on the material to be included in the appropriate volumes of the Methodology Review Handbook Series. The meetings described in this report are the fulfilment of these plans. As many of the participants were known to have expertise in both areas, the meetings were arranged to take place during two following weeks so that participants could more easily attend both meetings.

WORKSHOP I: GASEOUS SPECIES

2 OPENING

Participants were welcomed by representatives of the supporting organisations (Annex 5). Dr. Gwynne, UNEP, summarized the links between UNEP, Earthwatch and GEMS/AIR; Dr. Mage, WHO, described the role of WHO and the GEMS/AIR programme; Dr. Keune, UNEP-HEM, presented HEM's role in GEMS/AIR; Mr. Frank of BMW gave a talk on 'Air Quality Measurement, a Challenge for the Scientist' (Annex 6); Dr. Müller, BMU/UBA discussed the need for international harmonization, and interaction between industrialized and developing countries (Annex 7); and Professor Klein, GSF, briefly described the GSF Research Centre - the supporting organisation of HEM.

The basic approach to be used in the meeting was discussed in a preliminary evening session. Participants were invited to review, recommend changes to, and rewrite the background documents prepared for the workshops. These would be published in a series of handbooks which would contain information on the state of the art in air quality measurement, experience with different methods, and appropriate applications. These publications should have practical use for existing and potential GEMS/AIR programme participants. The workshop participants should not attempt to write the final publication, rather they should discuss the technical issues, modify the existing background papers, and outline the alterations that need to be made. Furthermore, participants should elaborate clear-cut recommendations on the most appropriate methods and procedures.

3 SELECTION OF CHAIR AND RAPPORTEUR, AND FORMATION OF WORKING GROUPS

Dr. F. Murray was elected chairman of the meeting and Mr. D. Krochmal rapporteur. Two groups of two parallel working groups (WG), i.e. a total of four groups, were formed. Their topics corresponded to the titles of the four background papers.

3.1 WORKING GROUP MEMBERS

Working Group I: Passive Samplers
Chair: M. Ferm, Rapporteur: A. Webster
D. Chibanda, J.B. Clements, J. Cui, M. Kirchner, K.J. Stevenson, H. Werner

Working Group II: Active Samplers
Chair: H.A. Wiebe, Rapporteur: J. Müller
J.S. Bower, N.S. Burenin, N. Frank, S. Garcia Dos Santos, Y. Hisamatsu, F. Murray, M.M. Nasralla, R. Orthofer

Working Group III: Primary standard calibration methods
Chair: K.J. Stevenson, Rapporteur: D. Chibanda
J. Cui, Y. Hisamatsu, D. Krochmal, A. Webster

Working Group IV: Intercalibrations and intercomparisons
Chair: J.B. Clements, Rapporteur: R. Orthofer
J.S. Bower, N.S. Burenin, M. Ferm, N. Frank, S. Garcia Dos Santos, M. Kirchner, J. Müller, F. Murray, M.M. Nasralla, H. Werner, H. A. Wiebe

4 DISCUSSIONS

4.1 WORKING GROUP TASKS

UNEP-HEM had prepared a preliminary agenda for each of the working groups, which was distributed to the chairs.

Working Group I: Passive Samplers

The task of WG I was to consider available passive sampling methods for different pollutants, reliability, ease of use, advantages and disadvantages, main sources of potential problems, practical experience with these methods, published sources of information (including detailed procedures), quality assurance and control, and appropriate and practical applications with particular reference to the GEMS/AIR network, and to make appropriate recommendations.

Working Group II: Active Samplers

WG II had the same tasks as WG I but for active sampling methods

Working Group III: Primary standard calibration methods

The task of WG III was to consider primary standard calibration methods: collating information on different calibration techniques, their suitability for measurements of different pollutants, ease of use and possible pitfalls, availability, potential application in the GEMS/AIR network (including consideration of the need for centralized facilities), and published sources of information, and to make appropriate recommendations.

Working Group IV: Intercalibrations and intercomparisons

The task of WG IV was to consider network intercalibrations and intercomparisons, available techniques, practical performance, experience of participants, application to sampler methodologies, application in the GEMS/AIR network, and published sources of information, and to make appropriate recommendations.

4.2 INTRODUCTION TO BACKGROUND PAPERS

Before commencing work in working groups, J.S. Bower and K.J. Stevenson of WSL, U.K. introduced the workshop background papers to the participants.

4.3 WORKING GROUP DISCUSSIONS

WG discussions were focused on the tasks outlined above and making recommendations for the planned publications using the background papers as a basis.

The rapporteurs prepared reports of the working group sessions detailing modifications to the text, further material to be incorporated, changes in emphasis and points which needed clarification. These were handed or sent to A. B. Murray at UNEP-HEM to be used as a basis for revising the background papers for publication in the GEMS/AIR Methodology Review Handbook Series.

In the plenary sessions, it was decided to collate the two background papers on active and passive samplers to form a single cohesive volume incorporating the additional suggested material (new title: Passive and Active Sampler Methodologies for

Air Quality Monitoring). The same was decided for the two papers on primary gas standards and intercalibrations (new title: Primary Standard Calibration Methods and Network Intercalibrations for Air Quality Monitoring).

4.4 FURTHER TASKS AND PREPARATION OF PUBLICATIONS

Joint Passive and Active Publication

The Introduction would be written by F. Murray using the points highlighted in the plenary session.

Passive sampling: Essentially the major revisions to this text were agreed. Various additions would be sent to the HEM office. Any further suggestions for fundamental changes should be discussed with M. Ferm before forwarding to UNEP-HEM.

Active sampling: A. Wiebe agreed to coordinate the collection of additional material and information which had been discussed by the WG, to be completed in 6 weeks.

Primary Standards and Intercomparisons

The Introduction would be written by F. Murray using the points highlighted in the plenary session.

All major changes were agreed.

Editing of final documents

It was agreed that UNEP-HEM would edit the final documents for publication. The final drafts need not undergo further peer review as the main points had already been agreed by this expert group. The final drafts would be sent to the original authors and chairpersons, and to participants who explicitly asked for it. A four weeks response time would be given for final comments.

Documentation of publication references

It was agreed that UNEP-HEM should attempt to obtain a hard copy of all references mentioned in the final publication in order to provide easy access of readers to the cited texts. This facility will be mentioned in an introductory sentence in section 6.

5 RECOMMENDATIONS

Recommendations were developed by each of the WGs and discussed, amended and agreed in the plenary sessions.

5.1 PASSIVE SAMPLERS

1) At present, although passive samplers for a number of species (in particular O_3, SO_2, HC's) are well advanced in their development, only those for NO_2 can be recommended for routine use.

2) In particular, passive samplers for ozone measurement are potentially very useful and should be developed to the point where they can be applied in routine monitoring.

3) NO_2 passive samplers offer the opportunity to undertake monitoring which cannot be completed by other methods. It is therefore recommended that:
   - more widespread use of passive samplers should be adopted,
   - passive samplers should be used to aid site selection for more sophisticated samplers, for regulatory purposes,
   - passive samplers be used to monitor personal exposure and indoor air pollution,
   - a world-wide survey of urban NO_2 concentrations should be undertaken,
   - standard procedures and QA samples should be prepared for GEMS/AIR stations.

4) Further development of passive samplers for gases other than NO_2 is needed.

5) The further development of O_3, CO, SO_2 and HC samplers should be promoted to enable their use in a much wider range of environmental conditions, and with the aim of their introduction for routine monitoring purposes.

5.2 ACTIVE SAMPLERS

6) SO_2: Sulphur dioxide specific measurements were recommended. For routine daily sampling, bubblers using dilute hydrogen peroxide solution or impregnated filters should be used with subsequent analysis by the Thorin colorimetric method. Other SO_2 specific measurement techniques are well developed and proven, and these will also provide useful data.

7) NO_2: Bubbler systems using the Griess-Saltzmann (ISO or TGS-ANSA) method were recommended for the routine daily measurement of NO_2.

   Other techniques, based on the use of thin film or glass filter sampling media, have been developed and used in some networks. However, these cannot as yet be recommended due to the limited data on comparison with other technologies and lack of experience with world-wide application in different types of environments.

8) O_3: The NBKI active sampling method cannot be recommended for the routine and specific measurement of ozone. This technique can, however, be more appropriately used for short-term oxidant investigations.

5.3 COMBINED RECOMMENDATIONS OF PRIMARY STANDARD CALIBRATION METHODS AND INTERCALIBRATIONS AND INTERCOMPARISONS

9) Reference gases or test solutions used for intercalibration should be prepared in suitably equipped primary standards laboratories.

10) Primary standard calibration laboratories should be established at a national or regional (international) level because of the facilities and methodologies required. These laboratories should provide transfer gas calibration standards for regular calibration and intercalibration of monitoring networks.

11) As an aid to harmonization of air quality measurements world-wide, it would be desirable for GEMS/AIR to organise occasional intercalibration exercises for primary gas standard laboratories.

12) Intercalibrations of reference gas standards, analytical laboratories and monitoring sites should be carried out at national or regional level. Different methodologies will be appropriate to different network types. The following intercalibration procedures are recommended:

CURRENT MONITORING NETWORK	RECOMMENDED PROCEDURES
Passive Samplers	• Comparison between passive and other methods is recommended when a variety of methods is used. • Intercalibration with other analytical laboratories is recommended. • Normal field intercalibration with standardized gases is not possible.
Active Samplers	• Intercalibration with other analytical laboratories is recommended using standard solutions. • Sites within and between networks may be intercalibrated with reference gases. • Field comparison against automatic analysers may be useful. • Field audits of operational procedures are recommended.
Automatic analysers	• Intercalibration between reference standards used by other laboratories is strongly recommended. • Sites within and between networks should be intercalibrated using reference gas sources or systems. • Field audits of operational procedures are recommended.

Data should always be re-evaluated following intercalibration exercises to reflect the results obtained.

6 CLOSE OF WORKSHOP

The workshop was closed by F. Murray with thanks to the chairs, the rapporteurs, the authors of the papers, the participants, the sponsors, the GSF and HEM, and the secretariat. Further comments, thanks and outlooks were expressed by various organisers and participants.

WORKSHOP II: SUSPENDED PARTICULATE MATTER (SPM)

7 OPENING

The workshop was opened by D.T. Mage (WHO/PEP Geneva) on behalf of the workshop organisers.

In his introduction to the workshop, D.T. Mage gave an overview of the history of Suspended Particulate Matter (SPM) monitoring in the GEMS/AIR programme. At the beginning of the programme monitoring of 'smoke' and 'TSP' was considered sufficient. The new GEMS/AIR programme calls for a better characterisation of SPM (chemical composition and size of particles) in order to better assess risks of SPM pollution on human health and to the environment, and to relate ambient levels to emission sources. Special attention has to be paid to the problems connected with QA/QC in SPM monitoring.

8 SELECTION OF CHAIR AND RAPPORTEUR, AND FORMATION OF WORKING GROUPS

N. Frank was elected chairman of the meeting and R. Orthofer rapporteur. Two groups of two parallel working groups (WG), i.e. a total of four working groups were formed. Their topics corresponded to the sections of the background paper.

8.1 WORKING GROUP MEMBERS

Working Group 1: Particle Size
Chair: H.A. Wiebe, Rapporteur: K.J. Stevenson
J.B. Clements, Y. Hisamatsu, S. Landsberger, D.T. Mage, F. Murray, M.M. Nasralla, R. Orthofer, V. Valkovic

Working Group 2: Phenomenology
Chair: J.S. Bower, Rapporteur: A. Webster
N.S. Burenin, D. Chibanda, J. Cui, K. Eickel, M. Ferm, R. Fernández Patier, N. Frank, S. Garcia Dos Santos, A. v. d. Meulen, K. Peters, F. Trautner

Working Group 3: Methods
Chair: N. Frank, Rapporteur: D. Chibanda
N.S. Burenin, J. Cui, K. Eickel, M. Ferm, R. Fernández Patier, S. Garcia Dos Santos, Y. Hisamatsu, F. Murray, M.M. Nasralla, R. Orthofer, K. Peters, K.J. Stevenson, F. Trautner

Working Group 4: QA/QC
Chair: S. Landsberger, Rapporteur A. Webster
J.S. Bower, J.B. Clements, A. van der Meulen, V. Valkovic, H.A. Wiebe

9 DISCUSSIONS

9.1 WORKING GROUP TASKS

UNEP-HEM had prepared a preliminary agenda for each of the working groups, which was distributed to the chairs.

Working Group 1: Particle Size

The task of WG 1 was to consider definitions of categories of particle size; the source relevance and impact relevance of different size categories (environment and human health, including considerations of the importance of knowledge about both size and composition of particles when assessing potential effects), and the relevance in terms of comparisons with existing data (time series), and to make appropriate recommendations.

Working Group 2: Phenomenology

The task of WG 2 was to consider the behaviour of SPM on a yearly basis, during high level air pollution episodes and in different geographic and climatic regions (e.g. arid vs. coastal). Particular attention should be paid to the problems of interpretation and comparability of SPM data obtained by similar methods in different situations and different methods in similar situations, and to make appropriate recommendations.

Working Group 3: Methods

The task of WG 3 was to collate information on available methods for sampling and analysing particulate matter, their advantages and disadvantages, practical applications, and published sources of information (including detailed procedures) - paying particular attention to the decisions made on the most relevant measure(s) and desirable analyses of SPM for GEMS/AIR, and to make appropriate recommendations.

Working Group 4: QA/QC

The task of WG 4 was to consider the basic steps necessary to ensure proper quality assurance of SPM measurements, paying particular attention to the recommendations made to GEMS/AIR following WGs 1, 2, and to make appropriate recommendations. Discussions should include siting considerations, reference equivalence procedures, and network intercomparisons.

9.2 KEY QUESTIONS

The chair of the meeting proposed that participants formulate specific questions to be considered in the working groups. Questions identified were:

9.2.1 Core questions

- What is the relevant particle size of concern?
- What chemical and physical characteristics are important to evaluate health and environmental effects (chemical composition related to particle size)?
- Which measurement method(s) for evaluation of health and environmental risks, and of source identification?
- How to provide and/or ensure QA/QC?
- How does siting affect measurements? What are the spatial and temporal patterns in an area? Where should samplers be placed?

- How to ensure data comparability with existing GEMS/AIR data if changes are made to sampler methods?
- Can measurements be related to present WHO guidelines?

9.2.2 Additional questions

- Can indicator parameters be used in place of direct measurement (e.g. black smoke for carbonaceous particles)?
- How to take account of artefact formation in existing and recommended methods?
- Which methods have broad applications in GEMS/AIR cities?

9.3 INTRODUCTION TO BACKGROUND PAPER

Before commencing work in working groups, A. van der Meulen of RIVM, Bilthoven introduced the workshop background paper to the participants. The overall aim of the paper was to provide the basis for an appropriate choice of SPM samplers for the GEMS/AIR programme in the next decade.

As additional background, S. Landsberger (Univ. Illinois, Urbana) gave a short presentation of his paper on 'Development of Particulate Filter Standard and its Use in an IAEA Interlaboratory Evaluation' during the plenary session. Results of this study show that errors of the multi-element analysis of particle samples can be very high, and that interlaboratory comparison is a powerful tool for identifying laboratory problems.

9.4 WORKING GROUP DISCUSSIONS

WG discussions were focused on the tasks outlined above and making recommendations for the planned publication using the background paper as a basis.

The rapporteurs prepared reports of the working group sessions detailing modifications to the text, further material to be incorporated, changes in emphasis and points which needed clarification. These were handed or sent to A. B. Murray at UNEP-HEM to be used as a basis for revising the background paper for publication.

The results of the WGs were discussed and agreed upon in the plenary session.

9.5 FURTHER TASKS AND PREPARATION OF PUBLICATIONS

The Introduction to the publication would be drafted by N. Frank and the Summary section re-drafted by S. Landsberger.

In addition to the reports mentioned above, participants agreed to submit various contributions as follows:
All participants: Important/necessary references to be included in the final publication; A. Webster: Information on the SPM pollution situation in developing countries to supplement Table 2.1; S. Landsberger: References on textbooks for air pollution instrumentation; overview of types of filters; overview of chemical analysis of samples; S. Garcia Dos Santos: Information on analysis of organic components in particulate filter samples; N. Frank: General discussion of U.S. experiences with TSP/PM10 measurements; D.T. Mage: Changes to Table 3.2.

Editing of final documents

It was agreed that UNEP-HEM would edit the final documents for publication. The final drafts need not undergo further peer review as the main points had already been agreed by this expert group. The final drafts would be sent to the original authors and chairpersons, and to participants who explicitly asked for it. A four weeks response time would be given for final comments.

Documentation of publication references

It was agreed that UNEP-HEM should attempt to obtain a hard copy of all references mentioned in the final publication in order to provide easy access of readers to the cited texts. This facility will be mentioned in an introductory sentence in section 6.

10 RECOMMENDATIONS

10.1 GENERAL

1) There are little if any particulate data for many environment types and global regions. GEMS should encourage particle monitoring in such circumstances, with emphasis on highly populated cities.

2) The minimum recommended requirement for particle monitoring under the GEMS programme is that it be sufficient to enable comparisons with the WHO daily and annual guidelines.

3) When measuring particle concentrations for the assessment of health effects, co-located measurements of sulphur dioxide are also recommended.

10.2 SIZE FRACTION

4) TSP should be monitored for health related assessment of certain chemical components, such as Pb, and for studies of environmental effects and source identification. In general, existing TSP monitoring should be continued.

5) In general, the thoracic fraction (PM10) should be monitored for assessing health effects.

10.3 SAMPLING WITHIN CITIES

6) Measurement locations should be sited in accordance with existing GEMS urban environment classifications and network design recommendations (WHO/UNEP, 1977), and reviewed periodically.

7) Target-oriented sites for sampling coarse particle fractions, may be appropriate to assess air quality impacts from local sources such as lead smelters or cement plants.

10.4 TIME OF SAMPLING

8) Twenty-four hour average concentrations should be measured.

9) Monitoring throughout the year is recommended to determine seasonal variations and representative annual averages.

10a) Sampling everyday is not strictly required to enable comparisons with annual average guidelines. As a minimum requirement, it is recommended that sampling be undertaken at least once every six days and more frequently where standard deviations are large.

10b) Sampling everyday is required if the maximum daily value in a year and the 98th percentile of daily averages in a year are to be reliably quantified for comparison with their criteria. Daily sampling is also necessary if epidemiological studies are to be conducted in the local population or to prevent a failure-to-monitor during an air pollution episode.

11) There is no requirement at this time for routine/baseline monitoring with hourly time resolution.

10.5 CHEMICAL ANALYSIS

12) Chemical characterisation of samples is recommended for the purpose of source attribution and the development of control strategies, particularly when measured levels of particulate matter are high when compared with guidelines.

13) Chemical characterisation is also recommended in some special circumstances, for instance in areas with point sources such as lead smelters, cities where leaded gasoline is utilized, or urban environments with high levels of diesel emissions.

14) In general, TSP (or TSPM) samples should be used for chemical analysis. For assessing health related effects or special studies, it may also be appropriate to select different size fractions.

10.6 SAMPLING METHODOLOGY

15) As a general rule, it is recommended that only proven and generally accepted measurement methods and instruments be used in monitoring studies.

16) The use of high volume samplers, with subsequent gravimetric analysis, is recommended for routine measurement of TSP. Glass fibre filters are recommended for routine TSP monitoring.

17) HVS or MVS with size selection inlet with subsequent gravimetric analysis is recommended for routine measurement of PM10.

18) Existing Black Smoke (BS) measurements may be continued provided that coal smoke from domestic fires is the dominant component of the particulate matter. It should not be continued where diesel smoke is an important contributor. It is

recommended that PM10 and TSP monitoring replace the BS monitors when practical, and no new BS monitoring be initiated.

19) For everyday measurement of PM10, automatic analysers might be considered provided that adequate resources are available.

20) When making a transition from one monitoring method to another, the methods should be co-located for a minimum of one year in order to better interpret long-term trends and air quality characteristics.

10.7 QA/QC

21) The general principles outlined in Volume 1 (UNEP/WHO, 1994) should be followed.

22) Thorough documentation of site selection should be performed, sites should be properly characterized and regularly reviewed.

23) All operational procedures should be fully documented.

24) Proper identification of field samples is essential.

10.8 MAINTENANCE, CALIBRATION AND INTERCALIBRATION

25) Maintenance should always be performed according to manufacturers' instructions.

26) Ideally, flow rate audits should be performed two to four times per year.

27) Periodic co-location of samplers should be used to evaluate any discrepancies.

28) It is strongly recommended that interlaboratory calibration be used for standard weights and chemical analysis.

29) All procedures should be independently audited on a regular basis.

11 CLOSE OF WORKSHOP

The workshop was closed by A.B. Murray (UNEP-HEM) on behalf of the workshop organisers with thanks to the sponsors, the workshop organisers, the chairs, the rapporteurs, and all participants.

LIST OF ABBREVIATIONS AND ACRONYMS

ANSA	8-anilino-1-naphthalene sulphonic acid ammonium salt
ARGE ALP	Arbeitsgemeinschaft Alpenländer (Association of Alpine Countries)
BAPMoN	Background Air Pollution Monitoring Network, WMO
BMU	Bundesumweltministerium (Federal Ministry of the Environment), FRG
BMW	Bayerische Motorenwerke
BS	Black smoke
GEMS	Global Environment Monitoring System
GSF	GSF Forschungszentrum für Umwelt und Gesundheit (GSF Research Centre for Environment and Health)
HC	Hydrocarbons
HEM	Harmonization of Environmental Measurement, UNEP
HVS	High volume sampler
IAEA	International Atomic Energy Agency
ISO	International Standardization Organisation
MARC	Monitoring and Assessment Research Centre, UNEP/GEMS
MVS	Medium volume sampler
NBKI	Neutral buffered potassium iodide
PEP	Prevention of Environmental Pollution, WHO
PM	Particulate matter
QA/QC	Quality assurance/quality control
RIVM	Rijksinstituut Voor Volksgezondheid En Milieuhygiene (National Institute of Public Health and Environmental Protection), NL
SPM	Suspended particulate matter
TGS	Triethanolamine guaiacol sodium metabisulphite
TOEM	Tapered element oscillating microbalance
TSP	Total suspended particulates
TSPM	Total suspended particulate matter
U.K.	United Kingdom
UBA	Umweltbundesamt (Federal Environmental Agency), FRG
US EPA	United States Environmental Protection Agency
WHO	World Health Organisation
WMO	World Meteorological Organisation

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ANNEX 4: AGENDA WORKSHOP I

UNEP-HEM/ WHO/ GEMS/ AIR WORKSHOP ON SAMPLER METHODOLOGIES IN AIR QUALITY MONITORING: AVAILABILITY, APPLICABILITY, AND QA/QC IMPLICATIONS.

I. GASEOUS SPECIES

Monday 7 September

17.00 - 19.30	Plenary (hotel conference room) Introduction to workshop, aims Introduction to participants Selection of Chairs and Rapporteurs Structure of Working Groups (WGs)/ discussion of Agenda General Arrangements
20.00-	Dinner (in hotel) by invitation of HEM

Tuesday 8 September

9.00 - 10.30	Plenary Opening session Introductory remarks on behalf of: UNEP, WHO, HEM, BMW, BMU/UBA, GSF
Refreshments	
11.00 - 13.00	Introduction to papers I and II: Passive Samplers, Active Samplers. Brief account of first results of ARGE Alp pilot project: comparison of passive samplers in ring test. Brief description of objectives of WGs, major comments for them to take into account.
Lunch	
14.00 - 16.00	Separation into WGs I: Passive Samplers; II: Active Samplers Part 1: methods
Refreshments	
16.30 - 18.30	WGs continued

Wednesday 9 September

9.00 - 9.30	Plenary Air Pollution Monitoring in Zimbabwe
9.30 -10.30	Report from WGs I, II
Refreshments	
11.00 - 13.00	Basic aspects of QA/QC: Introduction to papers III: Primary Standard Calibration Methods; and IV: Intercalibrations and Intercomparisons. Objectives of WGs, major comments for them to take into account.
Lunch	
14.00 - 16.00	WGs III, IV
Refreshments	
16.30 - 18.00	WGs III and IV continued

Thursday 10 September

9.00 - 9.30	Plenary Report from WGs III, IV. Recommendations to WGs I, II.
9.30 - 10.30	WGs I, II: Part 2: QA/QC for passive and active samplers, and practical applications particularly in the GEMS/AIR network.
Refreshments	
11.00 - 12.30	WGs I, II continued
Lunch	
14.00 - 16.00	WGs I, II continued
Refreshments	
16.30 - 18.30	WGs I, II continued

Friday 11 September

9.00 - 10.30	WGs I, II continued
Refreshments	
11.00 - 12.30	Plenary Recommendations: use of sampler methodologies (appropriate technologies) in the GEMS/AIR network.
Lunch	
14.00 - 15.00	Discussion of Introduction to publications
15.30 - 16.00	Closing remarks
16.00	Close of workshop

Sunday 13 September

Excursion to Garmisch Partenkirchen

8.30	Departure Munich
10.00 - 11. 00	Fraunhofer Institute for Atmospheric Research
12.00 - 13.00	Visit to the Wank air quality measurement station, and ARGE ALP passive sampler ring test platform.
13.00 - 14.30	Lunch
15.00 - 16.30	Visit to the Wank middle station, discussion (and viewing) of forest decline.
17.30	Return to Munich

ANNEX 5: AGENDA WORKSHOP II

UNEP-HEM/ WHO/ GEMS/ AIR WORKSHOP ON SAMPLER METHODOLOGIES IN AIR QUALITY MONITORING: AVAILABILITY, APPLICABILITY, AND QA/QC IMPLICATIONS.

II. PARTICULATE MATTER

Monday 14 September

9.00 - 9.30	Opening Remarks
9.30 - 10.00	Introduction of participants, aims of workshop Division into WGs. Selection of Chairs and Rapporteurs
10.00 - 10.30	Outline of paper. Summary of comments received.
Refreshments	
11.00 - 12.45	WG 1: Particle size: definition and relevance of particle size categories WG 2: SPM phenomenology
Lunch	(Demonstration of TEOM instrumentation by Rupprecht & Patashnik Co., Inc.)
14.00 - 16.00	WG session continued
Refreshments	
17.30 - 18.30	Plenary: Reports of WGs 1, 2 Discussion what size, what analysis results, are of most relevance for GEMS/AIR Recommendations to GEMS/AIR
19.00	Reception by invitation of the GSF

Tuesday 15 September

9.00 - 9.30	Description of a particulate filter standard
9.30 - 10.30	WGs 3, 4 WG 3: Measurement methods: sampling systems and analysis methods WG 4: Quality assurance and control
Refreshments	
11.00 - 12.30	WGs continued
Lunch	
14.00 - 15.30	WGs continued Recommendations to GEMS/AIR
Refreshments	
16.00 - 17.30	Report of WGs 3, 4
17.30 - 18.00	Summing up of recommendations
18.00	Close of workshop.

ANNEX 6: OPENING SESSION

UNEP-HEM/ WHO/ GEMS/ AIR WORKSHOP ON SAMPLER METHODOLOGIES IN AIR QUALITY MONITORING: AVAILABILITY, APPLICABILITY, AND QA/QC IMPLICATIONS.

Tuesday 8 September

9.00 - 10.30	Introductory remarks on behalf of: United Nations Environment Programme, World Health Organisation, Harmonization of Environmental Measurement, BMW, Bundesumweltministerium/ Umweltbundesamt, GSF-Research Centre for Environment and Health
UNEP	Dr. M. D. Gwynne UNEP, Earthwatch and GEMS/AIR
WHO	Dr. D. T. Mage WHO and the GEMS/AIR Programme
UNEP-HEM	Dr. H. Keune HEM's role in GEMS/AIR
BMW	Mr. D. Frank Air Quality measurement, a challenge for the scientist
BMU / UBA	Dr. J. Müller The need for international harmonization. Interaction between industrialized and developing countries
GSF	Prof. J. Klein GSF - the supporting organisation of UNEP-HEM

ANNEX 7: AIR QUALITY MEASUREMENTS - A CHALLENGE FOR SCIENTISTS

Dipl.-Ing. Detlef Frank, Board of Management of BMW AG for Traffic and Environment

Munich is a suitable location for a UNEP-HEM workshop. Munich's popularity as a conference location is based not only on its interest from a tourist perspective. Compared with other cities world-wide, it also has reasonably good air, even if its not ideal with regard to every emission component.

Munich is, moreover, the home of many industrial companies, including BMW. As BMW builds cars and cars are a known source of atmospheric pollution, you obviously also measure emissions from our cars in the course of your work.

BMW takes environmental concerns very seriously. For example, as early as 1983 we were the first car manufacturer in Europe to call for the harmonized world-wide launch of the catalytic converter as the most effective technical means available for reducing exhaust emissions. BMW became the first German car manufacturer to appoint a manager specifically to monitor the environmental standards of production facilities as far back as 1973, and in 1990 we again became the first German car manufacturer to create a "Traffic and Environment" department reporting directly to the Board of Management. Since I am responsible for this work area, I am particularly pleased to be addressing you here today.

Your work in harmonizing the measuring methods for environmental data as part of a global environmental monitoring system is of exceptional importance for several reasons. First of all, we need reliable data on atmospheric quality as we humans are unable to perceive airborne pollutants merely by using our sensory organs. For this reason, we are entirely dependent on scientific assistance in order to make reliable statements on the quality of the atmosphere.

Second, it is very important to harmonize measuring methods, as neither the atmosphere nor bodies of water are geographically limited. Keeping our air clean is therefore a global problem which can only be tackled successfully by means of globally harmonized methods and limit values.

A further reason for the importance of your work is that it constitutes the basis for our political decisions on environmental protection. After all, who would consider building a sturdy house on unstable foundations? Put even more emphatically, the quality of political decisions governing environmental protection depends directly on the quality of the measurements available!

This point emphasises your immense responsibility. On the one hand, you are expected to provide the basis for political decisions swiftly, comprehensively and reliably; on the other hand, you have a scientific responsibility to deliver precise and objective results. This is no easy task to do. I therefore feel it necessary to wish you more than a successful congress; it is my sincere hope that all of you, both when taking measurements and when involved in a dialogue between the worlds of science and politics, will always be able to calibrate your actions accurately. May your zero points never drift!

ANNEX 8: THE NEED FOR INTERNATIONAL HARMONIZATION. INTERACTION BETWEEN INDUSTRIALISED AND DEVELOPING COUNTRIES

Dr. J. Mueller, Federal Ministry for the Environment Federal Protection Agency (BMU/UBA)

Several national, regional and global programs for the measurement of air pollutants exist. However, in order to make data from different sites and measured with different methods reliable and comparable harmonization is indispensable. Minimum requirements have to be defined and fulfilled.

Many industrialised countries have highly sophisticated monitoring networks with automatic instruments which due to high costs and lack of infrastructure cannot be established in every country. Bur also measurements with simple and reliable wet chemical methods can be carried our to acquire an overlook about the concentrations of the main air pollutants. Partnerships with developing countries are desirable in order to create such networks.

Thus, the networks of GEMS/AIR and BAPMON are enlarged and more data become available to observe the trends and concentration gradients between urban, rural and remote sites in the world. Air pollutants according to their residence times and source distributions are either of local, regional or global relevance and sufficient control is realised by widespread dense monitoring networks.

Step by step a world-wide monitoring network can be achieved.

ANNEX 9: BACKGROUND PAPERS

1. PASSIVE SAMPLING METHODOLOGIES FOR MEASUREMENT OF AIR QUALITY prepared by K.J. Stevenson of Warren Spring Laboratory, Stevenage, U.K.

2. ACTIVE SAMPLING METHODS FOR MEASUREMENT OF AIR QUALITY prepared by G. McKinnes of Warren Spring Laboratory, U.K.

3. PRIMARY STANDARD CALIBRATION METHODS FOR AIR QUALITY MONITORING prepared by S. Eaton of Warren Spring Laboratory, Stevenage, U.K.

4. AIR MONITORING NETWORK INTERCALIBRATIONS AND INTERCOMPARISONS prepared by B.P. Sweeney of Warren Spring Laboratory, Stevenage, U.K.

5. SUSPENDED PARTICULATES prepared by A. van der Meulen of the National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands.

6. QUALITY ASSURANCE IN URBAN AIR QUALITY MONITORING, early draft of Volume 1, text based on a paper prepared by Mr. J.S. Bower of Warren Spring Laboratory, U.K.

7. WHO/UNEP URBAN AIR POLLUTION MONITORING. Report of a Meeting of UNEP/WHO Government-designated Experts, Geneva, Switzerland, 5-8 November 1991, WHO/PEP/92.2, UNEP/GEMS/92.A.1, Geneva, Switzerland, 1992.

ANNEX 10:PUBLICATION PLANS

UNEP/WHO GEMS/AIR Methodology Review Handbook Series, Vol. 1. Quality Assurance in Urban Air Quality Monitoring.

UNEP/WHO GEMS/AIR Methodology Review Handbook Series, Vol. 2. Primary Standard Calibration Methods and Network Intercalibrations for Air Quality Monitoring.

UNEP/WHO GEMS/AIR Methodology Review Handbook Series, Vol. 3. Measurement of Suspended Particulate Matter in Ambient Air.

UNEP/WHO GEMS/AIR Methodology Review Handbook Series, Vol. 4. Passive and Active Sampling Methodologies for Measurement of Air Quality.