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WORLD METEOROLOGICAL ORGANIZATION

REPORT OF THE WMO/UNEP EXPERT MEETING ON AIRBORNE POLLUTION OF THE MEDITERRANEAN SEA

Paris, 31 October to 4 November 1994

Organized in the Framework of the Long-term Programme
for Pollution Monitoring and Research in the Mediterranean Sea
(MED POL - phase II)

In co-operation with

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FOREWORD

Within the framework of the Mediterranean Action Plan (MAP) adopted by the governments of the region in Barcelona in February 1975, the Long-Term Programme for Pollution Monitoring and Research in the Mediterranean Sea (MED POL - phase II) was launched in 1981 as a result of successful implementation of the pilot programme MED POL - I implemented in 1975-1980.

Monitoring of the transport of pollutants to the Mediterranean Sea through the atmosphere is one of the four components of MED POL - phase II for which the World Meteorological Organization (WMO), since 1982, has been an agency responsible for initiating and co-ordinating the relevant activities and has co-operated with the United Nations Environment Programme (UNEP) responsible for overall co-ordination of MAP and MED POL.

The MED POL airborne pollution monitoring and modelling programme was prepared in November 1987 during the WMO/UNEP Workshop on Airborne Pollution of the Mediterranean Sea held in Belgrade. The Scientific and Technical Committee for MED POL agreed in May 1988 that this programme should be initiated within the framework of national MED POL monitoring programmes in as many countries as possible.

The major goals of the programme were identified as follows: to evaluate the importance of the atmospheric transport and deposition of land-based contaminants to coastal and open Mediterranean waters, to assess the airborne contamination levels of potentially harmful substances, to identify sources and source areas for these atmospheric contaminants, and to develop predictive models for assessing airborne pollution load.

The present meeting was organized by WMO in accordance with the MAP Programme and Budget for 1994-1995. Taking into account that the Seventh Meeting of the Contracting Parties to the Barcelona Convention (Cairo, Egypt, October 1991) agreed that an Expert Group on Airborne Pollution be established within MED POL, it was proposed that the meeting be held as the first meeting of the Expert Group and the National Co-ordinators for MED POL were invited to nominate their national experts to serve as members of the Expert Group and to participate in the meeting.

The meeting took place at the UNESCO Headquarters, Paris, France from 31 October to 4 November 1994.

1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1.1 The Expert Meeting on Airborne Pollution of the Mediterranean Sea was held from 31 October to 4 November 1994 at the UNESCO Headquarters in Paris, France. The meeting was organized and convened by WMO in the framework of the MED POL programme with financial support provided by the UNEP Coordinating Unit for the Mediterranean Action Plan. The premises for the meeting were kindly provided by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.

1.2 The meeting was attended by 27 participants including 17 experts from 11 Mediterranean countries, experts from Canada, Russia and Ukraine, representatives of WMO, UNEP and IAEA and observers from the UN ECE Convention on Long-range Transboundary Air Pollution (LRTAP) and the Arctic Monitoring and Assessment Programme (AMAP). The list of participants is given in Annex I.

1.3 The meeting was opened by Mr A. Soudine, WMO, who welcomed the participants on behalf of WMO and UNEP, briefed them about the developments in the MED POL airborne pollution monitoring and modelling programme since the Workshop in Monaco (April 1991) and outlined the main tasks confronting the present meeting. He noted some problems encountered in the organization of the meeting which originally was planned to be held in Spain (first in Barcelona and then in Madrid) but finally had to be conducted in Paris, and expressed regret that experts from Spain were not present, taking into account that a number of research groups in Spain participated in various international and national programmes dealing with atmospheric transport and deposition of pollutants (e.g. UN ECE Co-operative Programme for Monitoring and Evaluation of Long-range Transmission of Air Pollutants in Europe-EMEP) but did not participate in MED POL. Mr A. Soudine also noted with concern that almost a half of the MED POL National Co-ordinators did not reply to the initial letter about the present meeting and/or did not nominate the national experts to participate.

1.4 After a short discussion the meeting adopted the agenda which is attached as Annex II.

2. ELECTION OF OFFICERS

2.1 The meeting elected Mr G. Tuncel as chairman, Mr S. Guerzoni as vice-chairman and Mr G. Peplow as rapporteur of the meeting.

2.2 It was felt that some agenda items might need detailed consideration by ad hoc groups before being submitted to a plenary session. Having this in mind, Mr M. Graber was nominated as chairman of the ad hoc group on future work including MED POL-Phase III, Mr G. Tuncel - as chairman of the ad hoc group on data reporting formats and Mr S. Guerzoni - as chairman of the ad hoc group on quality assurance.

3. CURRENT NATIONAL ACTIVITIES

3.1 Mr S. Guerzoni presented a summary of replies to a questionnaire distributed by WMO in April 1993 on the status of monitoring stations, sampling protocols and analytical techniques. The more updated tables than the ones included in the document ENV/MED POL/AP/1 (Report of the WMO/UNEP expert consultation on quality assurance for the MED POL airborne pollution measurements, Ankara, 27 to 30 May 1993) were presented to the meeting and are given in Annex III (Tables 1 and 2 and Figure 1). It was noted that some stations had ceased to operate and some stations (e.g. from Egypt) still should submit or update the required information.

3.2 The participants then presented reports on current national monitoring and modelling activities related to the MED POL airborne pollution programme. Brief information on the current status of the activities as well as national and international actions needed to improve the present situation are summarized below.

(i) Albania - air pollution mesurements (SO_2, NO_x) are conducted in cities, most of the equipment is obsolete, there is no sampling equipment required for the MED POL programme and no heavy metal measurements are conducted.

ACTION: national action is needed to establish a monitoring station (with a basic measurement programme), to include this programme into the national MED POL programme (through the National Co-ordinator (NC) and UNEP) and to establish collaboration with a national institute capable of analysing heavy metals; financial support could be sought from international sources (Mediterranean Trust Fund - MTF) for obtaining sampling equipment.

(ii) Algeria - there is no MED POL monitoring station at present; Air Pollution Laboratory of the Centre de Recherche pour la Valorisation des Hydrocarbures et leurs Derives (CERHYD), Algiers is interested in participating in the programme; a high-volume sampler provided by WMO to the Meteorological Service seems to be defective and has not been used; training is needed.

ACTION: national action is needed to establish a monitoring station (e.g. by CERHYD) in co-operation with other organizations (e.g. with the Meteorological Service-MS), if necessary, for assessment of total deposition, to include this monitoring into the national MED POL programme (through NC and UNEP) and to ensure repair of the HV-sampler; the WMO Secretariat should help to transfer the HV-sampler from MS to CERHYD and to provide training; financial support would be needed from MTF.

(iii) France - there were a number of good monitoring stations which contributed to MED POL, some stations exist at present but for other international or national programmes (e.g. EMEP), there is no MED POL operational station at present.

ACTION: national action is needed to establish or designate at least one MED POL station.

(iv) Croatia - there are some monitoring stations but their locations and the measurement programmes are inadequate, financial assistance is needed at least for sampling equipment, there is a laboratory in Zagreb which could analyse heavy metals but it does not participate in MED POL.

ACTION: national action is needed to establish one-two background stations to assess total deposition and trends and to include this monitoring into the national MED POL programme (through NC and UNEP); help is needed (from WMO and UNEP) to establish collaboration with the laboratory in Zagreb and financial assistance to purchase sampling equipment.

(v) Egypt - there are three MED POL stations but their measurement programmes are inadequate (no heavy metal measurements).

ACTION: national action is needed to upgrade the measurement programmes (at least at one station) to assess total deposition and to identify sources of pollution; financial support is needed from MTF as well as training.

(vi) Israel - there are two MED POL (but not background) stations, some sampling equipment was provided through WMO, measurements (including heavy metals) are conducted but sampling frequency could be more regular, data are reported, some modelling and emission inventories are conducted.

ACTION: national action is needed to establish a background station and to upgrade measurement programmes; help is needed in establishing co-operation with international monitoring and especially modelling programmes (e.g. EMEP).

(vii) Italy - there is a good MED POL station in Sardinia operated by the Istituto di Geologia Marina (IGM), Bologna and its measurement programme is planned to be upgraded but the data are not reported to the MED POL data centre, there are also a number of stations participating in other international programmes (e.g. EMEP) but not in MED POL.

ACTION: national action is needed, on the part of the National Co-ordinator, to invite other stations to participate in MED POL and to nominate the station in Sardinia as a national (not only IGM) MED POL station and, on the part of IGM, to upgrade the measurement programme and to report data; WMO should help to establish closer co-operation between the Meteorological Service and IGM for the station in Sardinia.

(viii) Malta - a monitoring station is planned to be established, a HV-sampler was provided by WMO, analytical capabilities exist, emission inventory is in progress.

ACTION: national action is needed to establish the station and to include it into the national MED POL programme; assistance is needed to provide additional equipment and training (WMO, MED POL).

(ix) Morocco - there are two MED POL stations but only one HV-sampler is available, sampling frequency is not adequate and only a few data were reported.

ACTION: national action is needed to increase the sampling frequency and to improve data reporting; assistance is needed for additional sampling equipment (MTF) and to ensure access to the meteorological data required (WMO).

(x) Tunisia - one monitoring station was established in the 1980's but is not operational at present because of financial problems; 3-D regional transport modelling (ETA model) is conducted at the National Institute of Meteorology.

ACTION: the interested national institutes (which exist according to information available to WMO) and the National Co-ordinator should initiate some monitoring activities with the help of WMO and UNEP and possible financial support from MTF.

(xi) Turkey - there are two good stations with extended measurement programmes operated by the Middle East Technical University, Ankara and by the Institute of Marine Sciences/METU, Erdemli but data are not reported and only one station is officially nominated as a MED POL station, both stations are parts of the university research programmes but not a part of a national monitoring programme and might be closed in the near future.

ACTION: national action (by the National Co-ordinator and the Turkish Scientific Research Council) is needed to ensure long-term operation of the stations as a part of the national MED POL programme.

3.3 Available information on the status of air pollution measurements in the countries which were not represented at the meeting as well as the required actions are summarized below:

(i) Cyprus - there is a MED POL station, HV and rain samplers were provided, additional monitoring stations (for the WMO Global Atmosphere Watch programme and EMEP) is being established, measurements at present are not regular and data are not reported.

ACTION: national action is needed to ensure more frequent measurements and data reporting, and to establish close collaboration between national institutions involved in relevant measurements.

(ii) Greece - there are research groups interested in participation, HV sampler was provided to the Meteorological Service in 1986, there is a station participating in EMEP but no MED POL-related measurements are conducted at present.

ACTION: national action is needed to establish at least one MED POL station.

(iii) Slovenia - a monitoring station is planned to be established but financial support (especially for sampling equipment) may be needed.

ACTION: to speed up the establishment of the station; financial support could be sought from MTF.

(iv) Spain - there are four EMEP monitoring stations, one MED POL station was established which operates on a discontinuous basis; all the capabilities for participating in MED POL are available but there is no operational MED POL station at present.

ACTION: national action is needed to nominate at least one or two MED POL stations and to start participating in MED POL.

(v) Yugoslavia - there is a monitoring station, sampling equipment was provided in 1987-1989, measurements are conducted rather regularly and data are reported.

ACTION: some action is needed to upgrade the measurement programme and to improve quality of measurements.

3.4 At present there are no MED POL air pollution monitoring stations in Lebanon, Libyan Arab Jamahiriya and Syria and national ACTIONS are needed to initiate at least basic measurements.

3.5 The meeting requested the WMO Secretariat to send letters to the National Co-ordinators for MED POL and to the Meteorological Services in the Mediterranean inviting them to take all the possible measures for implementations of the required actions proposed by the meeting.

3.6 The meeting expressed concern that airborne pollution monitoring in many countries was conducted presently by universities and some research institutes as part of their own research programmes, which were of limited duration, and not as a part of the national long-term monitoring programmes. It was proposed that the MED POL National Coordinators be invited by WMO to consider this problem and advise on how to improve the situation.

3.7 Mr V. Medinets, Ukraine, presented a report on measurements of airborne pollution in the Mediterranean Sea (MED POL regions I, III, IV, VI, VII and VIII) carried out during research cruises in 1987-1991. Sulphur and nitrogen compounds were determined in about 2,000 samples and heavy metals in about 70 samples. The meeting was of the opinion that these data are of important scientific value and requested WMO to arrange that these data be published and become available for scientific assessments.

4. ASSESSMENT AND MODELLING

4.1 Mr L. Erdman, Russia, presented a report entitled "Assessment of Airborne Pollution of the Mediterranean Sea by Sulphur and Nitrogen Compounds and Heavy Metals in 1991" which was prepared for MED POL by the EMEP Meteorological Synthesizing Centre-East (MSC-E), Moscow at the request of WMO and UNEP, and published in September 1994 as the MAP Technical Reports Series Report No. 85. The report contains maps and figures of total, dry and wet depositions on the Mediterranean Sea, its ten sub-basins and adjacent countries, deposition densities, concentrations of the above pollutants in air and precipitation, monthly and seasonal variations, and contributions to the airborne pollution of the sea from individual countries. It was shown, for example, that in 1991 about 7400t of Pb, 2520t of Zn, 73t of Cd, 200t of As, 1400×10^3t of S and 1070×10^3t of N entered the Mediterranean Sea through the atmosphere and that atmospheric input of Pb and N is greater than the riverine input. The meeting highly appreciated the report which is the first preliminary assessment of pollution of the Mediterranean Sea through the atmosphere (based on modelling) and which would be useful for development of further monitoring and assessments as well as of control measures. It was recommended to widely distribute the report.

4.2 Mr S. Dutchak, representative of EMEP (MSC-E), informed the meeting about modelling activities within this programme where the modelling is an important component and is used for assessing air pollution concentrations in air and precipitation, total deposition over Europe, depositions from one country over another country(ies) and exceedings of actual depositions over the established "critical loads" (air pollution concentration or deposition levels below which adverse effects on specific ecosystems are not expected to occur). The models are also used to provide information on compliance with the adopted regional measures concerning airborne pollution reduction and to develop cost-benefit abatement strategies for emission reduction according to an optimized distribution of obligations to reduce pollution (in those areas or countries where it would be the most resultative), replacing the present flat-rate reduction obligations which require equal emission reductions in all countries.

4.3 Having discussed the report on the assessment (paragraph 4.1) the meeting stressed the urgent need for measurement data (especially for heavy metals) in the Mediterranean and updated emission data to improve and verify the modelling results. It was also recommended that similar assessments be made for Hg, dust and persistent organic pollutants (POPs), and that multiannual calculations (for 5-6 years) be made instead of calculations for one year which are less representative with respect to the long-term weather conditions.

4.4 The meeting noted that the actual input of airborne pollutants to the seas is bigger than the direct deposition to the sea surface since the rivers entering the seas transport also a substantial amount of pollutants of airborne origin which deposit to the watershed basin and come into the rivers with surface and underground run-offs. Rough estimates made for the atmospheric deposition of N over the Baltic Sea watershed show that about 10-20% of this deposition runs off to the rivers and then enters the sea. It was strongly recommended that similar estimates be made also for the Mediterranean.

4.5 The meeting also noted that backward trajectories of the atmospheric transport were very useful for interpretation of measurement results. The backward trajectories for the days of sampling are needed for the stations making daily measurements and the backward trajectory climatologies are useful for all stations. The WMO Secretariat was requested to send letters to the Meteorological Services in the region requesting them to assist national monitoring stations in this matter.

4.6 The need to stimulate, co-ordinate and assist in regional- and local-scale modelling in the Mediterranean was highlighted. In this connection the opinion was expressed that a regional modelling centre should be established or a modelling centre existing within other

programmes be used to this end. A representative of EMEP noted that, in principle, one of the EMEP centres could do this work under a contract with MED POL.

4.7 An ad hoc group was established by the meeting to prepare recommendations on future modelling activities and on modelling requirements. The recommendations of the ad hoc group are given in Annex IV.

5. MEASUREMENT PROTOCOL AND QUALITY ASSURANCE

5.1 Mr G. Tuncel presented a report of the WMO/UNEP Expert Consultation on Quality Assurance for the MED POL Airborne Pollution Measurements, Ankara, 27 to 30 May 1993 (document ENV/MED POL/AP/1) which contains recommendations on sampling and analysis protocols, intercomparisons and quality assurance, and data reporting. The meeting discussed and adopted, in principle, the recommendations which were taken into account in a draft MED POL manual (see paragraph 5.5) and in preparation of recommendations on intercomparison (5.6), data reporting formats and procedures (6.2-6.4), and on the future activities (7.2).

5.2 Mr S. Guerzoni and Mr G. Quarantotto informed the meeting about a laboratory intercomparison exercise organized in 1994 by WMO and the Institute of Marine Geology, Bologna to check the sample treatment procedures (digestions) and analyses of heavy metals. Reference aerosol samples (exposed Whatman filters) and blank filters were sent to 16 laboratories in the Mediterranean (Croatia, Cyprus, Egypt, France, Israel-2, Italy, Malta, Monaco, Morocco, Slovenia, Spain, Turkey-2, Yugoslavia and MEL/IAEA) which were requested to make the acid digestion of the samples (filters), to analyse a half of the digested solution (for heavy metals) and to send the second half to a central laboratory in Italy for analysis. The results were compared with "true values" produced by the central laboratory. From 16 laboratories only 8 laboratories actually conducted the intercomparison (from Cyprus, Italy, Malta, Morocco, Turkey-2, Yugoslavia, and MEL/IAEA). It was proposed that for future intercomparisons WMO should send letters to the National Co-ordinators for MED POL encouraging better participation in these exercises.

5.3 The results of the intercomparison (see Annex V) showed that the main disparities occurred in the analytical techniques rather than in the digestions. The meeting proposed that each laboratory participating in the programme be provided with certified standard solutions and that another intercomparison be organized preferably in 1995 or 1996.

5.4 Mr A. Soudine presented preliminary results of intercomparisons of analyses of rain samples organized by WMO in 1993 and 1994 to check the measurements of major ions and heavy metals (HM). In 1993 the reference samples were sent to 13 laboratories in the Mediterranean. Eight laboratories reported their results (of which two laboratories did not analyse heavy metals). In 1994 the samples were sent to 15 laboratories. List of participating laboratories and some results of the analyses of heavy metals are given in Annex VI.

5.5 Mr G. Tuncel presented a draft Manual for the MED POL Stations: Sampling and Analysis of Aerosols and Precipitation for Major Ions and Trace Elements which he prepared at the request of WMO. The meeting participants briefly discussed the manual and expressed their appreciation to Mr G. Tuncel for the excellent work. It was proposed that the manual should also include recommendations on Hg measurements and Chapter II (Sampling of Atmospheric Aerosol) should be amended in 1995 (after an intercomparison of aerosol samplers scheduled for May 1995) with respect to recommended sampling and sample treatment and handling procedures for measurements of heavy metals. It was agreed that comments on the draft manual should be sent to Mr G. Tuncel by January 1995.

5.6 To prepare recommendations on an intercomparison and training exercise for high-volume samplers to be held in 1995, an intercalibration of precipitation chemistry measurements and on a future quality assurance plan for the MED POL airborne pollution measurements,

an ad hoc group was established by the meeting. The recommendations of the ad hoc group as adopted by the meeting appear in Annex VII.

5.7 Mrs M. Horvat (MEL/IAEA) noted that pollution of the Mediterranean Sea through the atmosphere by mercury is likely to be significant since about 65% of the world's Hg deposit are located in this region. She noted recent improvements in analytical techniques for measuring Hg in air and proposed that Hg be added to the MED POL Airborne Pollution Monitoring Programme. Realizing that the Hg measurements could be expensive and difficult for many Mediterranean countries the meeting agreed that these measurements could be included in an extended programme during MED POL-Phase III (see Annex IX, page 3).

6. DATA REPORTING FORMATS AND PROCEDURES

6.1 Mr A. Aksel briefed the meeting on the computerization of the MED POL marine pollution data, presented the modular structure of the PC-ORACLE based database and its subsystems, and explained the system design principles. This was followed by a summary of the airborne pollution component of the database. Presently six Mediterranean countries report monitoring data on air pollution, including the precipitation matrix, but not all of them do this regularly. Moreover, due to the lack of simple common data reporting formats, the data reporting has not yet been standardized. In addition to this urgent need, importance of the data transfer on magnetic media was also stressed.

6.2 To review the existing airborne pollution monitoring formats for data reporting and information required by the questionnaire on this type of monitoring (see paragraph 3.1), the formats presented in the MED POL Data Transfer Formats and the Codes Manual, and to prepare new formats an ad hoc group was established by the meeting. The ad hoc group considered in detail the following formats: (a) characteristics of the airborne pollution monitoring station; (b) monitoring frequency; (c) aerosol/gas sampling and analysis characteristics, and (d) precipitation sampling and analysis characteristics. The above formats as developed by the group and adopted by the meeting appear as Annex VIII (Tables 1-4) to this report.

6.3 The ad hoc group also reviewed the parameters (and their units for pollutant measurements in air and precipitation) that were included into the MED POL Codes Manual, and made some corrections and amendments. The agreed list of parameters and units is given in Annex VIII Table 5.

6.4 The meeting agreed that the timely and regular data reporting is of paramount importance for the successful implementation of the programme, in general, and in particular for verification of modelling results and preparation of regional assessments. The meeting urged all the stations to implement the agreed data reporting procedures and agreed that the data for a previous year should be sent to the MED POL data centre in Athens (directly or through WMO) by 1 May of the current year.

6.5 While considering a draft report of the meeting a question was raised about the reporting of data for bulk and dry-only sampling (in addition to air sampling (filtering) and precipitation sampling) included in the basic and extended measurement programmes for MED POL-Phase III (see Annex IX, page 3) since the corresponding data reporting formats were not discussed and have not been included in the formats adopted by the meeting (Annex VIII). One of the solutions could be: a) to add a new field to the Sampling Information (Table IV, annex VIII) to indicate the sampling type (precipitation- or wet- only, bulk and dry-only) and b) to create another column (bulk and dry-only deposition) in Table 5, Annex VIII for a deposition unit (mass/unit area). In any case, for bulk and dry-only samples it should be ensured that these samples are identified and that data analysts should know how to handle these data. A final recommendation on this matter could be made at the beginning of MED POL-Phase III.

7. FUTURE WORK INCLUDING MED POL-PHASE III (1996-2005)

7.1 Mr A. Soudine informed the meeting about recent MED POL activities aimed at developing the objectives, structure and implementation strategies for MED POL-Phase III (1996-2005) which is expected to be oriented not only at monitoring and assessments but also at the development of concrete recommendations on pollution control and prevention measures. The following documents were presented for consideration and discussion: UNEP(OCA)/MED WG.75/3; UNEP(OCA)/MED WG.75/2/Rev.1; UNEP Regional Seas Report No. 28, Rev.1; MAP Technical Reports Series Nos. 31 and 64, and draft proposals of WMO for MED POL-Phase III.

7.2 To consider the future work with regard to the airborne pollution monitoring, modelling, assessment and control during the MED POL-Phase III, an ad hoc group was established by the meeting. The MED POL-Phase III programme activities for monitoring and assessment of inputs of pollutants through the atmosphere as agreed by the meeting appear in Annex IX. It contains overall objectives and basic principles, detailed proposals for reference and impact monitoring programmes and assessments, for research, capacity building, formulation of control measures, co-operation and co-ordination. It was agreed that these proposals should be submitted to corresponding bodies of the Parties to the Barcelona Convention to be taken into account in developing future activities within the Convention and MED POL.

7.3 The meeting noted that the Seventh Ordinary meeting of the Contracting Parties to the Barcelona Convention (Cairo, October 1991) had agreed that an expert group on airborne pollution be established. The urgent need to officially establish such an expert group as soon as possible was stressed. The proposed terms of reference of the Expert Group on Airborne Pollution of the Mediterranean Sea as agreed upon by the meeting are attached as Appendix I to Annex IX. It was proposed that the terms of reference be submitted to appropriate bodies under the Barcelona Convention for final approval and to ensure that the group could start its work and meet regularly (every two years). The national experts to the group should be nominated by the National Co-ordinators.

8. OTHER MATTERS INCLUDING CO-OPERATION WITH OTHER ORGANIZATIONS AND PROGRAMMES

8.1 Mr L. Bjorkbom, Chairman of the Working Group on Strategies of the ECE Convention on LRTAP, presented reasons for co-operation between the LRTAP and Barcelona Convention. The work programme of LRTAP over the next coming years will be focused on nitrogen compounds, persistent organic pollutants and heavy metals. These are also compounds of great importance to the work of the regional seas conventions on pollutants from land-based sources in the European regions. Much of these pollutants deposit from the atmosphere to the open seas and still more in the catchment areas of the regional seas and then are further transported to the seas via rivers. Both the Helsinki Convention on the Baltic Sea Area (HELCOM) and the Oslo and Paris Conventions on the North-East Atlantic Sea Area (OSPAR) have since many years established co-operation with the EMEP monitoring system. Lately both these conventions have made moves to establish closer co-operation with LRTAP with a view to better co-ordinate work both in the substantiation phase and on measures that could be taken to abate emissions and discharges of these groups of pollutants. Such moves are met with positive reactions from the various working groups and negotiating and decision-making bodies within LRTAP.

8.2 It was considered important from the LRTAP side that the BARCOM also was brought into this co-operation. It should be a step forward if the MED POL, as a first step, could participate at the next meeting of the LRTAP Executive Body in late November this year. It was foreseen that also representatives from HELCOM and OSPAR would be present at that meeting. It was suggested by Mr Bjorkbom that one should aim at a pragmatic approach when developing the needed co-operation between the work of the regional seas conventions and that of the LRTAP. He warned against establishing formal coordinating

groups between the conventions at least at the present juncture. The aim should be to establish mutually supportive links that would minimize double work and mutually use the experiences and knowledge developed within the various conventions in areas of common concern.

8.3 Mr D. Stone, Chairman of the Arctic Monitoring and Assessment Programme (AMAP) reported on his activities. AMAP was established as a component of the "Declaration on the Protection of the Arctic Environment", signed by Ministers from the eight Arctic countries in Tovuniemi, Finland in 1991. The objectives of MAP are to monitor the levels of, and assess the effects of anthropogenic pollutants in all components of the Arctic environment. However, the Ministers have instructed that priorities for AMAP are heavy metals, persistent organic pollutants (POPs), radionuclides and (in a sub-regional context) acids. AMAP is managed by a working group composed of representatives from each Arctic country and with the support of a Secretariat provided by Norway. The basic monitoring programme was designed by the working group and is delivered through the development of individual national implementation plans. The output of AMAP will be large comprehensive reports on the state of the Arctic environment, the first of which will be provided to the Ministers in 1997.

8.4 AMAP is as far as possible using existing data centres for the processing and storage of data (e.g. ICES). Quality assurance and control measures are required to be specified for all data submitted to the programme. In addition, recommendations for method performance criteria and quality control measures for determination of POPs in air, precipitation and water have been developed and are also being considered by EMEP (UN-ECE LRTAP Convention). AMAP would be interested in sharing with MED POL experiences in the establishment and maintenance of monitoring activities.

8.5 Mr R. Guardans, Vice-Chairman of the Working Group on Effects summarized the methods used in LRTAP to develop effects-based air pollution reduction protocols and the results obtained so far with the "critical load" methods for acidity, sulphur and nitrogen and informed the meeting that in 1991, the Executive Body of the UN-ECE Convention on Long-range Transboundary Air Pollution (LRTAP) established a Task Force on Persistent Organic Pollutants. The Task Force was asked to undertake the work necessary: to substantiate information on emissions, long-range transport, distribution between media, and abatement strategies; to provide by 1994 the basis for possible protocol. The Task Force has concluded that the global inventory of POPs is increasing and extensive long-range transport is occurring, primarily through the atmosphere. Many POPs biomagnify extensively, leading to the occurrence of much higher values in biota, including human dietary items and body tissues, than are seen in the abiotic environment. POPs are implicated in immunological, reproductive, developmental, behavioural, carcinogenic and hormonal effects. The Task Force has therefore recommended that since national and sub-regional controls of POPs emissions are limited in their effectiveness for substances capable of extensive long-range atmospheric transport, the development of a protocol dealing with POPs should be considered under the LRTAP Convention. The Executive Body will consider these suggestions in late November 1994.

8.6 The meeting was of the opinion that co-operation with the mentioned above advanced programmes (especially with LRTAP in which at least half of the Mediterranean countries participate) would be of great benefit for MED POL and proposed that the representative of WMO should attend a meeting of the Executive Body of the LRTAP Convention in 1994, to inform them about relevant activities within MED POL and to make a proposal for establishing a close co-operation. It was also proposed that a representative of the LRTAP Convention be invited to a meeting of the MAP Scientific and Technical Committee to be held in 1995.

8.7 Mr M. Horvath (MEL/IAEA) briefed the meeting about the MEL's activities on the preparation of UNEP's Reference Methods for Marine Pollution Studies and proposed that the MED POL Manual (see paragraph 5.5) be published also as one of these Reference Methods.

8.8 It was also proposed by the meeting that the Co-ordinating Unit for MAP and WMO should explore possibilities to organize (in co-operation with interested countries and organizations) international expeditions (cruises) for collecting data on airborne pollution in the open part of the Mediterranean Sea and for conducting intercomparison exercises and training.

8.9 The meeting noted information that an airborne pollution monitoring programme is being considered to be established within the Black Sea programme and recommended that co-operation with this programme in relevant fields be also established when appropriate.

9. ADOPTION OF THE REPORT AND CLOSURE OF THE MEETING

9.1 A draft report of the meeting was adopted in principle and it was agreed that the draft will be completed by the WMO Secretariat and submitted to the meeting participants for comments, amendments and final approval.

9.2 It was proposed that the report of the meeting be published as a UNEP/MAP-WMO document.

9.3 The meeting was closed at 16.30 on Friday, 4 November 1994. Mr G. Tuncel, Chairman of the meeting and Mr A. Soudine, WMO, thanked the participants for their valuable contributions to the meeting outcome and wished them every success in their work and in the realization of the meeting recommendations.

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ANNEX I

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ANNEX II

AGENDA OF THE MEETING

1. Opening of the meeting and adoption of the agenda
2. Election of officers
3. Current national activities
4. Assessment and modelling
5. Measurement protocol and quality assurance
6. Data reporting formats and procedures
7. Future work including MED POL-Phase III (1996-2005)
8. Other matters including co-operation with other organizations and programmes
9. Adoption of the report and closure of the meeting.

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**) Observer*

ANNEX III

CURRENT STATUS OF MED POL AIRBORNE POLLUTION MONITORING STATIONS AND MEASUREMENTS

Table 1. Summary characteristics of stations for aerosol sampling and analysis in the MED-POL 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 fiber filter	AAS, S (UV-spec)
MOROCCO (2) (Tangiers)	Regional	Pb, Cd, Zn, Cu, $SO^{=}_4$	Monthly	Hi-Vol Sampler, Glass fiber filter	AAS, S (UV-spec)
ISRAEL (1)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S	Weekly	Hi-Vol Sampler (Aquero), Glass fiber filter	ICP
ISRAEL (2)	Coastal (regional)	Ca, Cu, Mg, Cd, Pb, Zn, S	Weekly	Hi-Vol Sampler (Aquero), Glass fiber 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	
TUNUSIA (currently not operational)	Background	Cd, Pb, Zn, Na, Al, SO_4, ^{137}Cs	Weekly		
YUGOSLAVIA	Coastal (regional)	SPM	Daily	Hi-Vol sampler (Aquero) Glass fiber 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

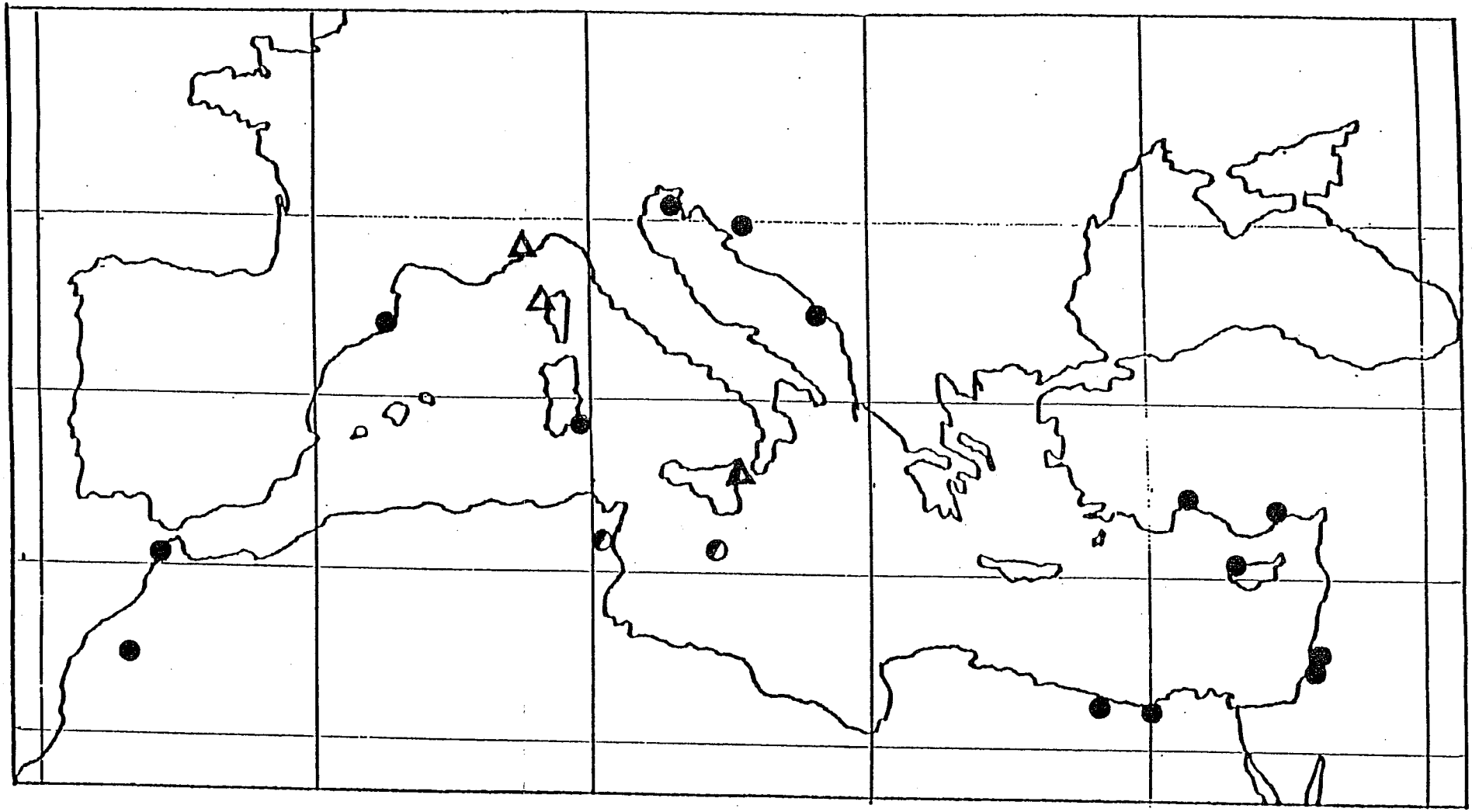
[†]Stations from countries which responded to WMO questionnaire are included in the table

Table 2. Summary characteristics of stations for deposition sampling and analysis in the MED-POL 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; Homemade 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.)

[†]Stations from countries which responded to WMO questionnaire are included in the table

Figure 1. MED POL Airborne Pollution Monitoring Stations



● existing stations

◐ stations being planned

△ stations which were operational

ANNEX IV

MODELLING REQUIREMENTS AND RECOMMENDATIONS FOR FUTURE MODELLING ACTIVITIES

1. MODELLING REQUIREMENTS

1.1 Basic requirements

1.1.1 Emission data

(a) Total emissions per year for S, N, Cd, Pb, Zn and As on a spatial scale of 150 km x 150 km,
(b) Seasonal variability of emissions*,
(c) Total emission from major sources or source areas,
(d) Size distribution of emitted particles*.

1.1.2 Meteorological data (preferably for every 6 or 24 hours, or at least on a monthly basis)

(a) Horizontal wind speed at 10* m above the surface and at the levels of 1000, 925*, 850, and 750 hPa,
(b) Vertical velocity at the levels 850 and 700 hPa,
(c) Air temperature at 2 m above the surface and at the levels of 1000, 925*, and 850 hPa,
(d) Humidity at 2m* above the surface and at the levels of 1000 and 850 hPa,
(e) Turbulence coefficients at the Planetary Boundary Layer (PBL),
(f) PBL heights,
(g) Cloudiness,
(h) Precipitations,
(i) Sea surface temperature.

1.1.3 Geographical data

(a) Geographical co-ordinates of the grid cells,
(b) Geographical co-ordinates and heights of major sources and source areas,
(c) Surface types for every grid cell (land, sea or coastal) and the heights above the sea level,
(d) Land use and vegetation types*.

1.1.4 Chemistry data

(a) Chemical and physical parameters and forms of the considered pollutants,
(b) Dry and wet deposition rates measured or assessed for local conditions,
(c) Coefficient of major chemical reactions and transformations (including O_3 formation).

1.1.5 Measurement data

(a) Monthly concentrations of major pollutants in air and precipitation from at least 6-7 background stations,
(b) Monthly estimates of total and dry depositions for at least 6-7 background stations,
(c) Episodic results of concentration measurements in the open sea during research cruises,
(d) Monthly concentration and deposition measurements in the vicinity of major sources.

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*) Supplementary information

1.2 Additional requirements

(a) Total emissions per year for major pollutants on a spatial scale of 50 km x 50 km,
(b) Total emissions for Hg, V, Cu, Ni, Cr and persistent organic pollutants (POPs) (150 x 150 or 50 x 50),
(c) Measurement data for the pollutants mentioned in 1.2.2,
(d) Size distribution of particles in air collected at the monitoring stations.

2. MODELLING ACTIVITIES AND APPLICATIONS

2.1 Basic modelling

(a) To update monthly and annual calculations of wet and dry depositions and concentrations in air and precipitation for S, N, Cd, Pb, Zn and As for the Mediterranean Sea, its sub-basin and adjacent countries using the existing models and updated information on emissions,
(b) To provide information on seasonal and spatial distributions of depositions on regional and sub-regional scales,
(c) To verify model calculations on the basis of measurement results for the Mediterranean,
(d) To calculate atmospheric transport and deposition for Hg and dust,
(e) To conduct multi-annual and trend calculations,
(f) To estimate deposition of N on the Mediterranean Sea watershed basin and the run-off of the airborne N to the sea,
(g) To calculate daily backward trajectories for some monitoring stations making daily measurements and trajectory climatologies for other stations,
(h) To nominate a regional centre responsible for co-ordination of modelling activities in the region and for conducting regional assessments,
(i) To stimulate, co-ordinate and assist in developing sub-regional and local scale models.

2.2 Additional modelling activities

(a) To improve the existing and to develop new models for atmospheric transport and deposition,
(b) To develop models for photochemical oxidants and persistent organic pollutants (POPs),
(c) To develop and apply models for optimal cost-benefit abatement strategies for emission reductions in the region and thus for reduction of pollution of the sea through the atmosphere,
(d) To develop and apply models to providing information on compliance with adopted regional measures concerning reduction of airborne pollution of the sea,
(e) To apply models for making recommendations on locations of new powerful air pollution sources to minimize their effect on the sea,
(f) To calculate atmospheric transport and deposition for some air pollution episodes,
(g) To calculate dry deposition fluxes accounting for particle size distribution,
(h) To apply models for testing the reported emission data on the basis of measurement results,
(i) To develop models for assessing the transfer of airborne pollutants from the atmosphere to the sea water column and then to the marine sediments.

ANNEX V

SUMMARY OF THE INTERCOMPARISON OF HEAVY METAL ANALYSES IN AIR (FILTERS), 1994

INTRODUCTION

The intercomparison of sample treatment and analysis procedures used by the laboratories participating in the MED POL Airborne Pollution Monitoring Programme was recommended by a WMO/UNEP Expert Meeting on Quality Assurance for the MED POL Airborne Pollution Measurements held in Ankara, Turkey from 27 to 30 May 1993 (Report ENV/MED POL/AP/1, Athens, 1994).

At the request of WMO the Institute of Marine Geology (IMG) Bolognia, Italy (Dr S. Guerzoni and Mr G. Quarantotto) prepared two intercomparison samples: a blank Whatman 41 filter (W41F) and a Reference Aerosol Sample (RAS). The RAS filter (taken from the same set of filters as the blank one) was exposed to air pumping at a monitoring station in Sardinia, Italy. The concentrations of metals in both samples were determined with high precision using various digestion and analysis techniques and were considered later as "true values".

Two strips of each filter (taken from different parts of W41F and RAS to ensure better homogeneity) were put into Teflon bottles and two bottles (with parts of W41F an RAS) were sent to each of the laboratories participating in the intercomparison (in Croatia, Cyprus, Egypt, France, Israel-2, Italy, Malta, Monaco, Morocco, Slovenia, Spain, Turkey-2, Yugoslavia and the Marine Environment Laboratory (MEL) of IAEA in Monaco).

The participating laboratories were advised to prepare aliquots of each sample (W41F and RAS) and to divide them into two parts. One part of each sample should have been analysed at the participating laboratory (**Laboratory data**) and the second part should have been sent to WMO for further analysis at a central laboratory (IMG)(**WMO check data**). That procedure allowed to conduct the intercomparison of both sample treatment procedures and analyses.

PROCEDURE FOR DIGESTION AND HANDLING OF REFERENCE AEROSOL SAMPLE (RAS) AND BLANK WHATMAN 41 FILTER (W41F)

You have received two samples in Teflon bottles. One is a blank Whatman 41 filter (W41F) and the other is the Reference Aerosol Sample (RAS). Make the extraction procedure in parallel, as to work in exactly the same way for both samples. This will also be useful to check the clearness of the blank solution in the HNO_3 - reflux step. Keep the Teflon empty bottles closed. They should be cleaned (as described below) and used for sending half of the prepared aliquots to WMO for further analyses at a central laboratory.

Transfer all the filter strips of each bottle, using plastic tweezers, into a Teflon FEP 250 ml beaker (one for blank and another for the RAS).

Add 30 ml of high purity concentrated HNO_3 and put a plastic (Teflon if available) cover on the beaker.

Put the beaker on a sand bath and set the temperature controller at 130/$\pm$ 10 degrees centigrade. Switch the bath on and check the increasing temperature up to the desired value by inserting a thermometer into the sand. Keep the thermometer inserted to continuously check the temperature.

Allow the refluxing of HNO_3 for 10-12 hours. Check the clearness of the solutions, especially that of the blank sample (the RAS one may not be completely clear at this stage, due to the particles).

Refluxing means that the acid does not escape the bottle due to the cover. It evaporatesand recondenses continuously, so very little evaporation occurs. Normally during refluxing there is no possibility of obtaining dryness.

At this point the solution should be clear, if not, take an additional step by adding some more acid (up to a total of 20 ml) and allow refluxing (by leaving the cover on) for 6-8 more hours.

Remove the cover from the beaker and reduce the acid volume down to approximately 10 ml.

Add 5 ml of concentrated HF, cover the beaker and allow refluxing for 6-8 hours.

(NOTE: Up to this stage do not leave the cover of the beaker open except for acid additions)

Remove the cover from the beaker and continue to bring the sample to a near dryness stage but avoiding to bake the sample !!!

Add 5 ml of concentrated HNO_3 and repeat the evaporation until nearly dry and the white fumes of HF should no longer be visible. If necessary repeat this step two/three times. When the sample becomes clear, bring it to a dryness stage and remove the beaker from the hot bath, to allow cooling.

(This step is very important to completely remove HF from the solution and to avoid damages to nebulizer and other parts of the AAS)

Redissolve the residue with 1% HNO_3, transfer the solution to a 50 ml graduated volumetric flask and make up to 50 ml (with the same 1% HNO_3 solution). This volume step should be very precise.

(1% nitric acid = 1.5 ml of concentrated HNO_3 in 100 ml of DDW)

Handling of the Final Solution

Take approximately 25 ml (exact volume is not important at this step) from the 50 ml flasks with the prepared W41F and RAS aliquots and put these solutions back into the original Teflon bottles, rinsed and washed several times with double distilled water (DDW). Close tightly the bottles and wrap with parafilm to avoid any loss of samples, then send the two bottles (clearly labelled) immediately to WMO. These are the samples for control analyses by the central laboratory and should arrive as soon as possible at WMO.

Take the remaining 25 ml of each of the subsamples in one Teflon or polyethylene bottle (pre-washed with 1% HNO_3 acid and rinsed several times with DDW) for your analyses.

For major elements (Al, Na) you can take 5 ml of concentrated solution and dilute it 5 to 10 times.

For trace elements (Cd, Cu, Pb, Zn) make the determination directly using the concentrated solution.

General Comments

While using HF safety precautions should be taken. Gloves and protecting lenses should be worn. Labware exposed to HF should not be glass or quartz. Contamination should be always avoided mainly during transfer from beaker to flask, during subsampling and transfer from flask to the bottles. All labware and glassware must be pre-washed with diluted acid and rinsed with DDW. All acids must be of "suprapure-type".

SOME RESULTS OF THE INTERCOMPARISONS

From 16 laboratories including a laboratory in Italy (central laboratory) to whom the reference samples were sent only 8 laboratories actually conducted the intercomparison and reported their results (Cyprus, Italy, Malta, Morocco, Turkey-2, Yugoslavia and MEL/IAEA). The list of laboratories who actually participated in the intercomparison and analytical methods used by them are given in Table 1.

The results of analyses of RAS aliquots performed by the participating laboratories are given in Table 2a (**Laboratory data**) and the results of analyses of RAS aliquots prepared by the laboratories and analysed by the central laboratory are given in Table 2b (**WMO check data**). The concentrations units are μg/ml for Al, CU, Na, Pb and Zn, and ng/ml for Cd. Both results are also presented in Figure 1 (in concentration values) and in Figure 2 (in Z scores: $Z = (X - X_t)/\sigma_t$, where X = analytical value obtained by each laboratory, X_t = true value, and σ_t = standard deviation from the true value; the cut-off for $|Z|$ values is 8, i.e. all Z values which are higher than +8 or lower than -8 are shown as $|Z| = 8$).

The results of the intercomparisons for RAS show that the main disparities occurred in the analytical techniques rather than in the digestions. That stresses the need for all laboratories to strictly follow the recommended digestion procedures and to take all the necessary precaution measures to avoid possible contamination of samples during the digestion.

The results of the analyses of the blanks (W41F)(Table 3a, 3b and Figure 3 show bigger disparities than for RAS which could be explained by the fact that concentrations of the blank solutions were near the detection limits for some elements (Cd, Pb and Zn).

It is recommended that the laboratories participating in the MED POL Airborne Pollution Monitoring Programme be provided with certified standard solutions (with metals) to check their analyses and that another similar intercomparison exercise be organized in 1996.

TABLE 1. PARTICIPATING LABORATORIES AND THE ANALYTICAL METHODS USED

Laboratory Code	Country	Method	Notes
1	Italy	AAS	F/GF
2	Cyprus	AAS	F/GF
3	Malta	AAS	F/GF
4	Morocco	AAS	
5	Monaco	ICP-MS	
6	Turkey 1	AAS	F/GF
7	Turkey 2	AAS	F/GF
8	Yugoslavia	F.Phot.-AAS-DPASV-DCUSA	
True value		***AAS*-ICP-ASV***	*F/GF

AAS = Atomic Absorption Spectrometry
ICP-MS = Inductively Coupled Plasma-Mass Spectrometry
F.Phot. = Flame Photometry
DPASV = Different Pulse Anodic Stripping Voltametry
DCUSA = D.C.U. - Shaped Arc
ASV = Anodic Stripping Voltametry
F/HG = Flame/Graphite Furnace

TABLE 2. ANALYTICAL RESULTS FOR ALIQUOTS OF THE REFERENCE AEROSOL SAMPLE (RAS) as measured by the participating laboratories (Laboratory data) and by the central laboratory (WMO check data). Units µg/ml for Al, Cu, Na, Pb and Zn, and ng/ml for Cd.

Table 2a - Laboratory data

Lab/element	Al	Cd	Cu	Na	Pb	Zn
1	27.6	5.22	1.41	70.8	0.42	0.34
2	na	<0.1	0.75	na	na	0.13
3	5.2	8.76	1.69	6400	0.11	0.36
4	na	0.35	<0.1	0.48	0.07	na
5	12.4	2.95	1	17.4	0.26	0.24
6	na	1.18	1.65	56.2	0.21	0.32
7	20.6	3.5	1.03	62.4	0.53	0.29
8	27.2	<0.1	0.05	75.3	0.33	<0.1
True value	***27.5***	***3.87***	***1.52***	***72***	***0.36***	***0.36***
St. dev.	***1***	***1.6***	***0.13***	***2.2***	***0.07***	***0.04***

Table 2b - WMO check data

Lab/element	Al	Cd	Cu	Na	Pb	Zn
1	27.4	5.06	1.62	72.7	0.38	0.35
2	23.5	47.2	1.64	79.6	0.75	0.35
3	23.9	7.62	1.49	75.3	0.43	0.39
4	45.8	2.55	2.07	110.2	0.33	1.14
5	24.3	3.66	1.54	74.1	0.43	0.33
6	21.9	6.31	1.65	75.7	0.50	0.35
7	24.9	5.73	1.5	74	0.39	0.4
8	28.1	<0.1	0.2	74.5	0.34	<0.1
True value	***27.5***	***3.87***	***1.52***	***72***	***0.36***	***0.36***
St. dev.	***1***	***1.6***	***0.13***	***2.2***	***0.07***	***0.04***

na = not analysed

FIGURE 1. ANALYTICAL RESULTS FOR ALIQUOTS OF THE REFERENCE AEROSOL SAMPLE (RAS)
(see also Table 2)

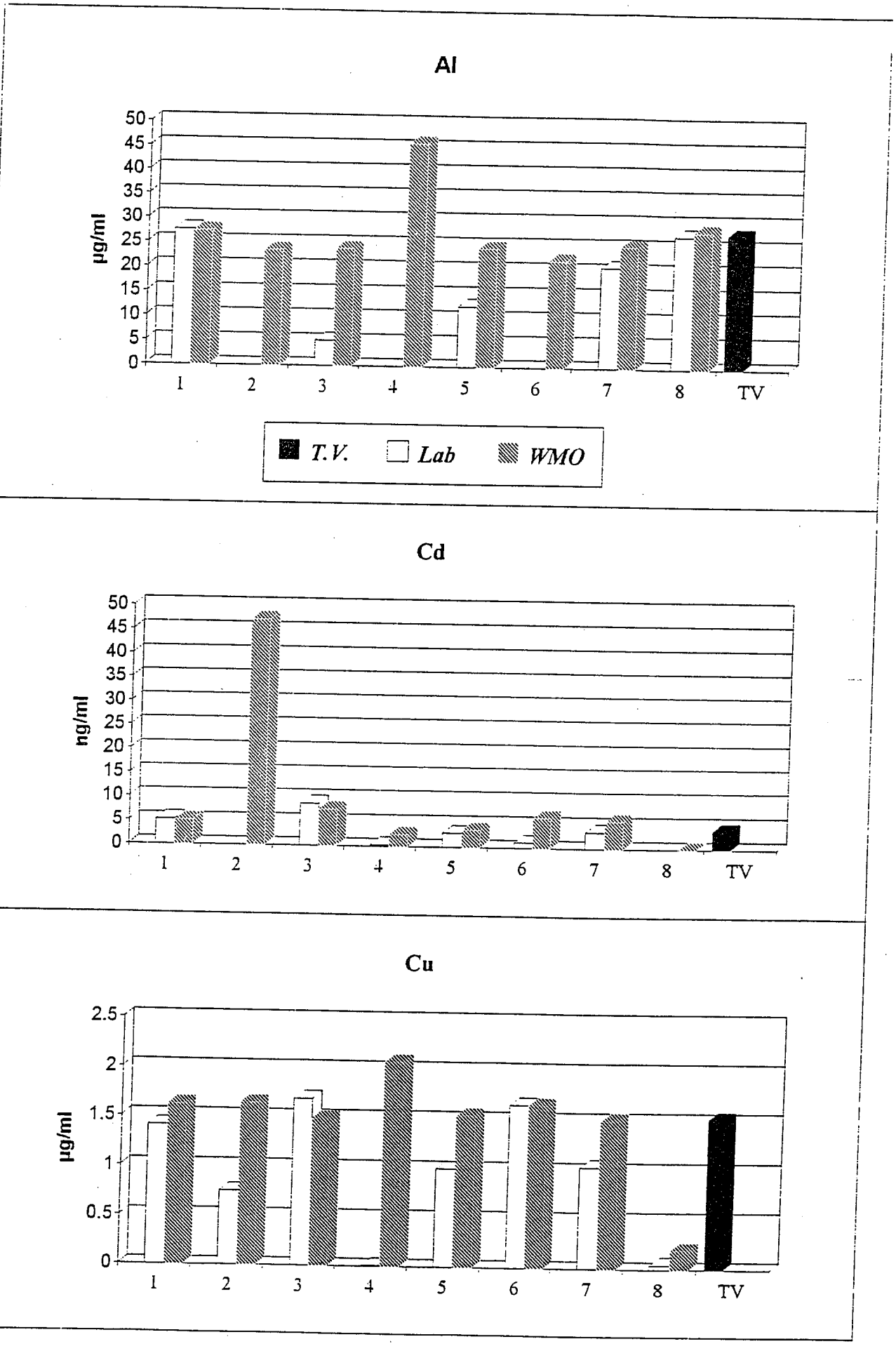


FIGURE 1 (continued)

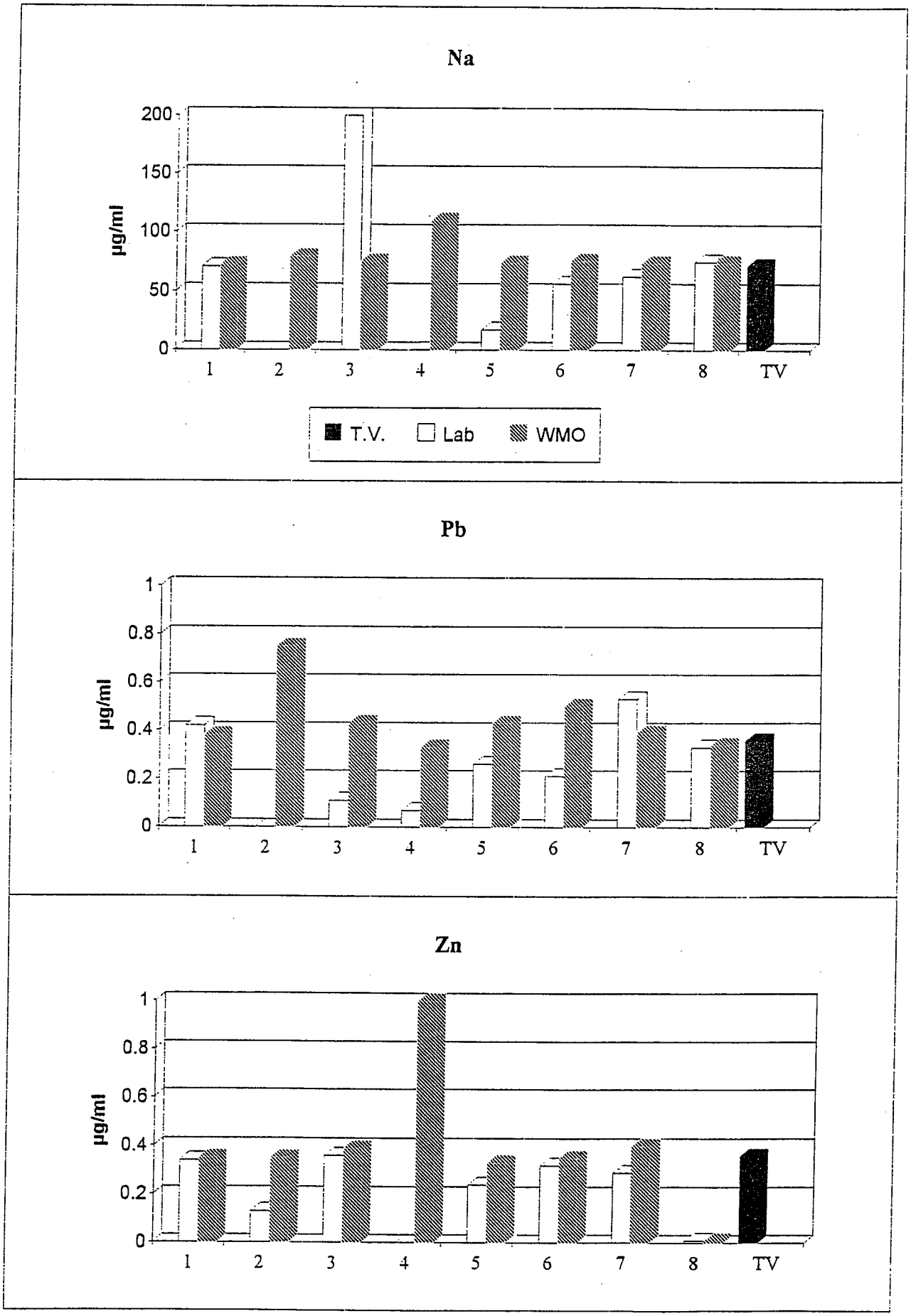


FIGURE 2. ANALYTICAL RESULTS FOR ALIQUOTS OF THE REFERENCE AEROSOL SAMPLE (RAS) presented as Z scores (see text, Annex V)

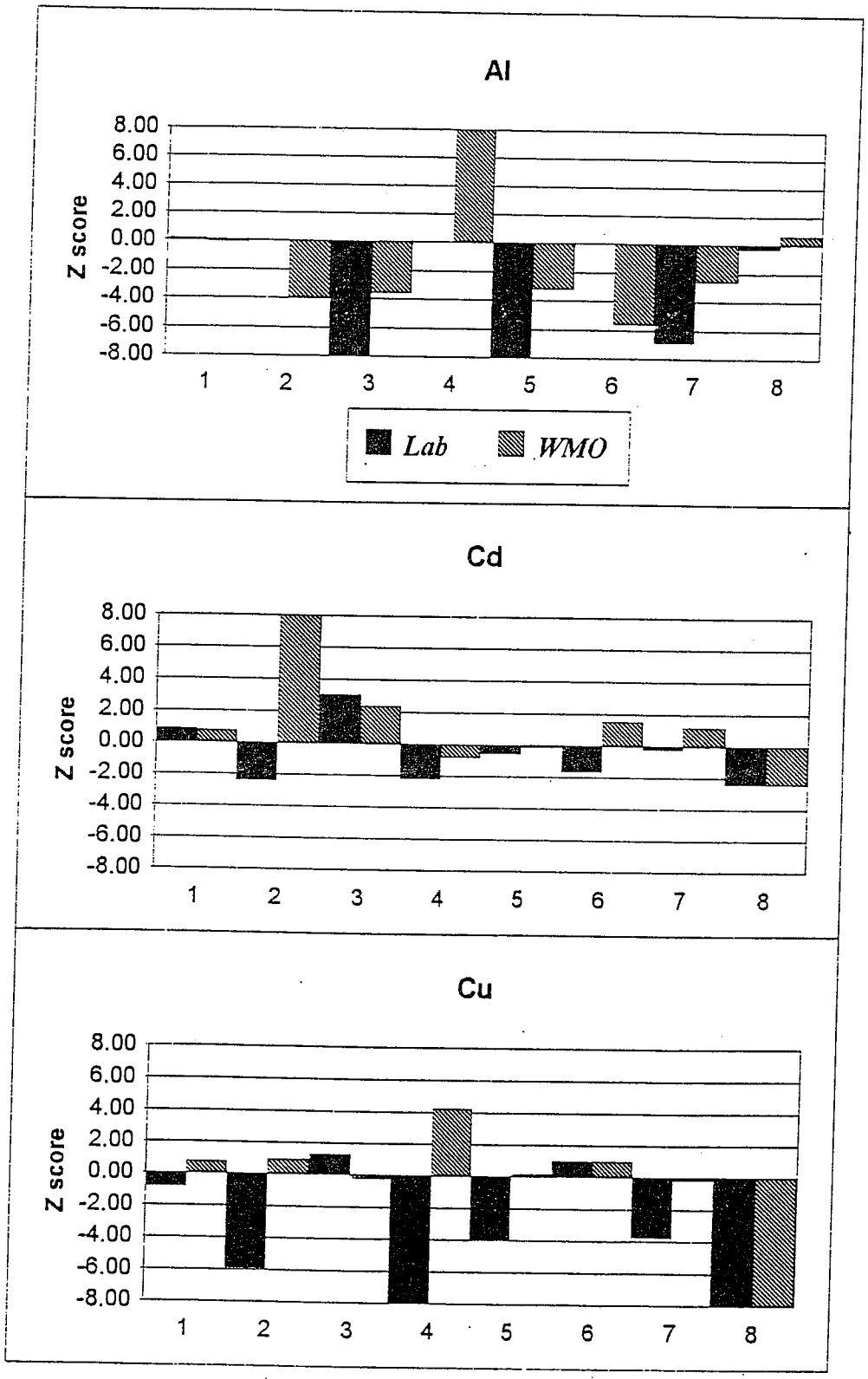


FIGURE 2 (continued)

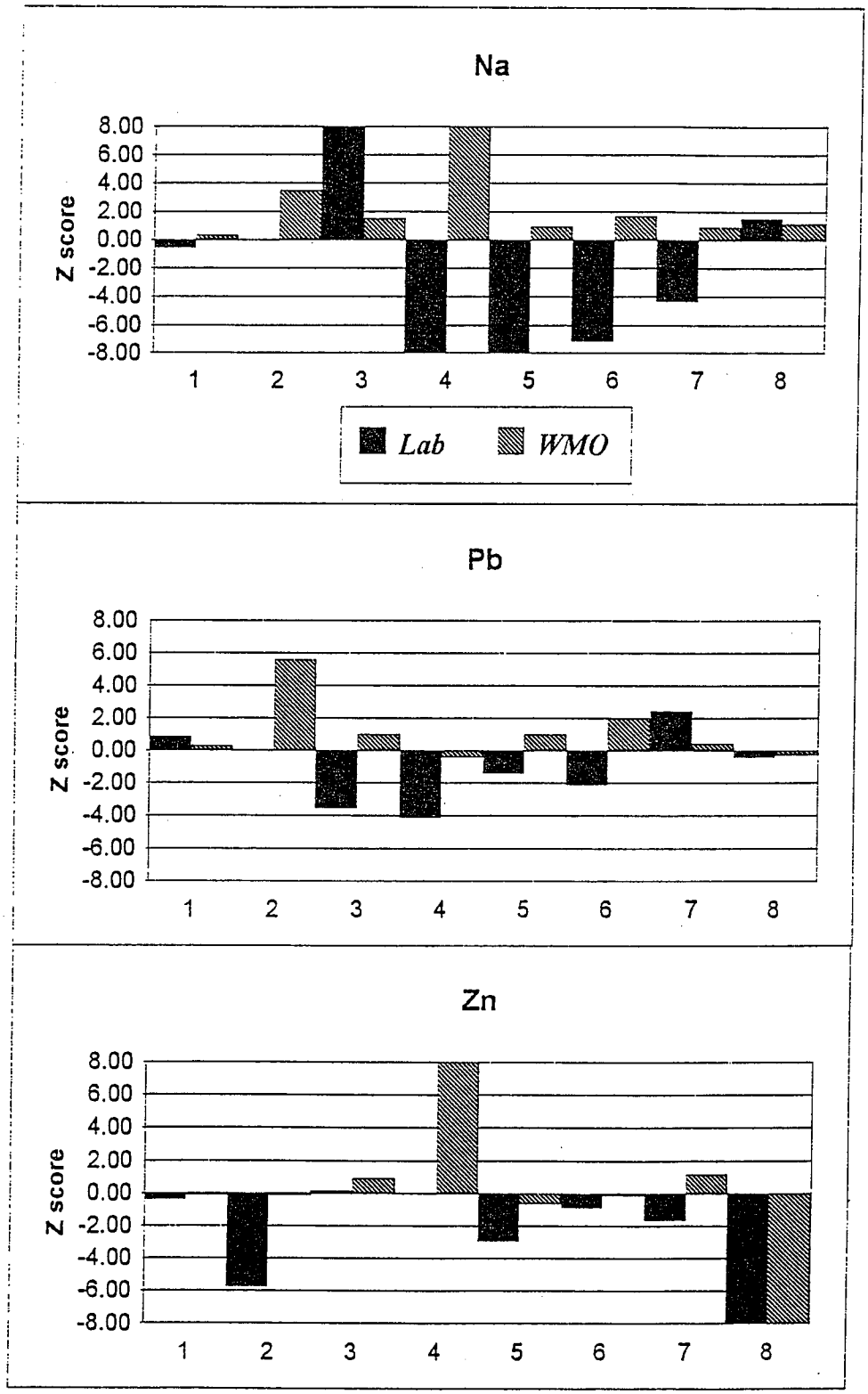


TABLE 3. ANALYTICAL RESULTS FOR ALIQUOTS OF THE BLANK WHATMAN 41 FILTER (W41F) as measured by the participating laboratories (Laboratory data) and by the central laboratory (WMO check data). Units: µg/ml for Al, Cu, Na, Pb and Zn, and ng/ml for Cd

Table 3a- Laboratory data

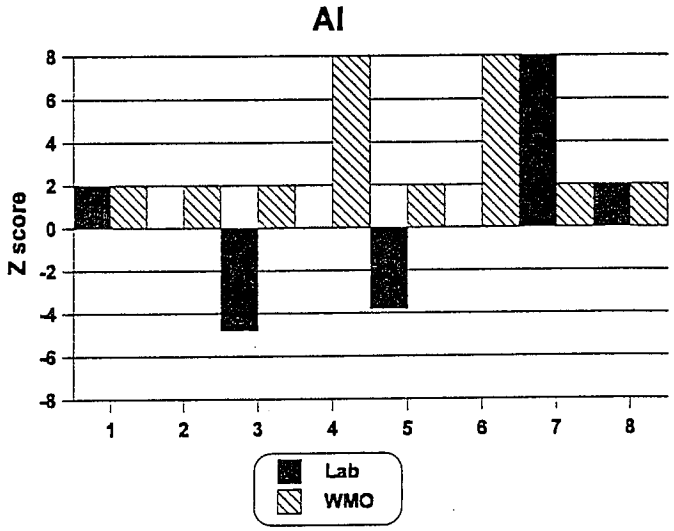
Lab/element	Al	Cd	Cu	Na	Pb	Zn
1	<0.5	0.72	0.02	0.76	0.02	0.02
2	na	0.02	0.02	na	na	0.03
3	0.16	0.4	0.01	0.54	0.1	0.03
4	na	0.09	<0.01	<0.01	<0.01	na
5	0.21	0.42	0.01	2.34	<0.01	0.04
6	na	0.42	0.05	0.77	<0.01	0.05
7	9.1	0.08	na	3.8	0.04	0.01
8	<0.50	30	1.3	8.7	0.12	0.81

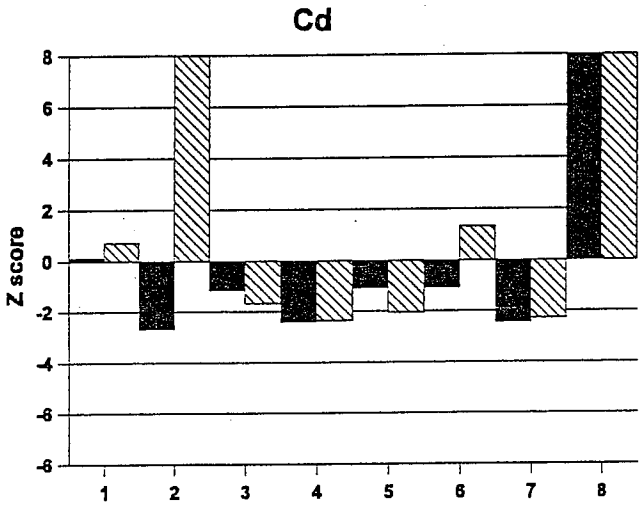
Table 3b - WMO check data

Lab/element	Al	Cd	Cu	Na	Pb	Zn
1	<0.5	0.87	0.02	0.73	0.01	0.03
2	<0.5	3.4	0.02	1.55	0.06	0.06
3	<0.5	0.27	0.01	1.48	0.01	0.02
4	1.26	0.1	0.43	3.66	0.04	0.82
5	<0.5	0.18	0.01	0.5	<0.01	<0.02
6	3.42	1.02	0.07	5.49	0.02	0.03
7	<0.5	0.12	0.01	0.86	0.03	<0.02
8	<0.5	26.85	1.37	2.29	0.07	1.02
True value	***0.400***	***0.690***	***0.022***	***0.710***	***0.018***	***0.028***
St. dev.	***0.050***	***0.250***	***0.004***	***0.090***	***0.006***	***0.007***

na = not analysed

FIGURE 3. ANALYTICAL RESULTS FROM ALIQUOTS OF THE BLANK WHATMAN 41 FILTER (W41F) presented as Z scores (see text, Annex V)





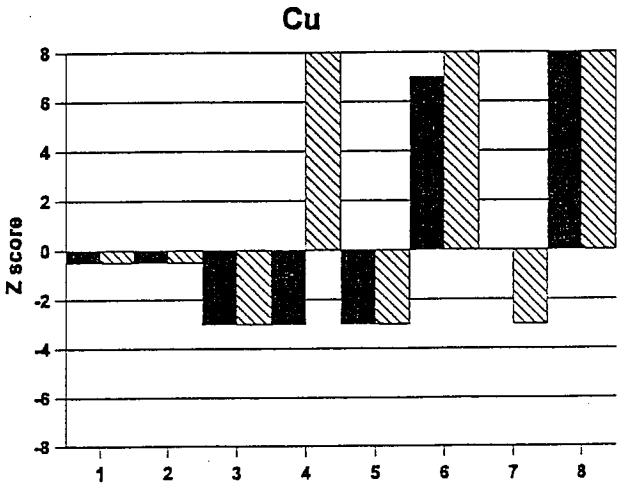
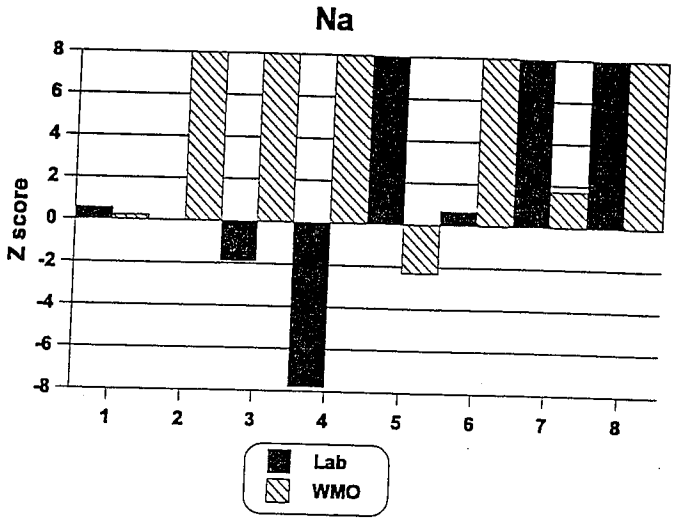
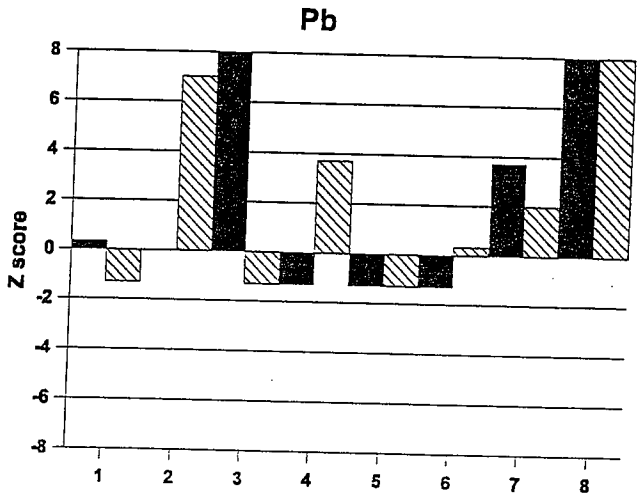
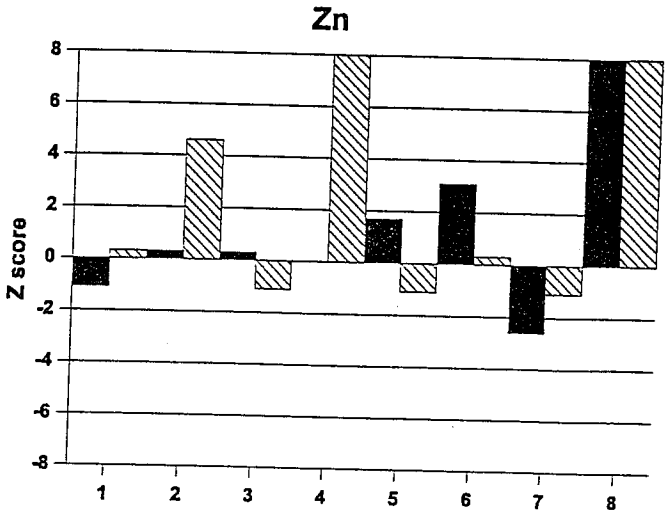


FIGURE 3 (continued)







ANNEX VI

PARTICIPATING LABORATORIES AND SOME RESULTS OF INTERCOMPARISONS OF ANALYSES OF HEAVY METALS IN PRECIPITATION

LIST OF MEDITERRANEAN LABORATORIES THAT PARTICIPATED IN INTERCOMPARISONS IN 1993 AND 1994 TO CHECK THE RAIN-WATER ANALYSES

1. Office national de la Meteorologie
   B.P. 153 Dar El Beida
   Algiers
   Algeria

2.* Chemical Laboratory
   Meteorological and Hydrological Service
   Gric 3
   41000 Zagreb
   Croatia

3. State General Laboratory
   44 Kimonos Str.
   Nicosia 138
   Cyprus

4. Service des Equipements et Techniques Instrumentals
   de la Meteorologie
   7 rue Teisserone de Bont
   B.P. 202
   78195 Trappes Cedex
   France

5. Universite de Paris 7
   2 place Jussieu
   75 Paris Cedex 05
   France
   (for Cape Verde)

6. Ministry of Environment, Regional Planning
   and Public Works
   147 Patisson Street 112 51
   Athens
   Greece

7.* Hadera Association of Towns for Environmental Protection
   P.O. Box 3041
   Hadera
   Israel

8.* Istituto di Geologia Marina
   Via Gobetti 101
   40129 Bologna
   Italy

9.* Dip. Scienze della Terra
   University of Cagliari
   Via Trentino 51
   09127 Cagliari
   Italy

10. Vigna di Valle Met. Observatory
00062 Bracciano
Rome
Italy

11.* Atmospheric and Marine Pollution Laboratory
Ecole Mohammadia d'Ingenieurs
B.P. 765
Agdal-Rabat
Morocco

12. Societe Agricole de Services au Maroc
206 Allee des Jardins Ain Sebaa
Casablanca
Morocco

13. Centro Nacional de Sanidad Ambiental
Ctra. Majadahonda a Pozuel Km. 2
28220 Majadahonda (Madrid)
Spain

14.* Department of Environmental Engineering
Middle East Technical University
Inonu Bulvari
06531 Ankara
Turkey

15.* Institute of Marine Sciences
Middle East Technical University
P.O. Box 28
33731 Erdemli-Icel
Turkey

(*) - laboratories participating in MED POL

Table 1. PARTICIPATION IN THE INTERCOMPARISONS

	1993		1994	
Countries	Samples sent	Results reported	Samples sent	Results reported
Algeria	-	-	+	-
Croatia *	+	+ (no HM)	+	+ (no HM)
Cyprus	+	+	+	+
France	+	+	+	+
France	+	-	+	-
Greece	+	-	+	-
Israel *	+	-	+	-
Italy *	-	-	+	-
Italy	+	+ (no HM)	+	+ (no HM)
Italy *	+	+	+	+
Morocco	+	+	+	+
Morocco *	+	-	+	+
Spain	+	+	+	+
Turkey *	+	-	+	-
Turkey *	+	+	+	+
* MED POL stations				

HM - measurements of heavy metals

Table 2. SOME RESULTS OF HEAVY METALS ANALYSES AT THE PRECIPITATION CHEMISTRY INTERCOMPARISON - 1993

		Deviations from "true values" in %				
LABORATORIES	SAMPLE No.	Cd	Pb	Zn	Cu	Ni
1	5 4	+ 100 + 75	+ 41 + 15	+ 122 + 13	- 14 + 30	+ 164 + 96
2	5 4	- 100 - 50	+ 28 + 21	+ 11 + 40	+ 18 - 6.8	+ 7 + 25
3	5 4	+ 100 0	- 6 - 11	+ 144 + 14	0 - 2.7	+ 21 + 4
4	5 4	ND ND	ND ND	+ 5233 + 5212	+ 4627 + 4831	ND ND
5	5 4	0 0	+ 9.4 + 4.6	+ 10 + 9.4	- 9 - 4	+ 43 + 25
6	5 4	+ 200 + 75	+ 100 + 54	+ 211 +1275	0 - 26	- 36 - 38
True values (mg/l)	5 4	0.001 0.004	0.032 0.109	0.009 0.064	0.022 0.073	0.014 0.024

ND - not detected or measured

Table 3. SOME RESULTS OF HEAVY METALS ANALYSES AT THE PRECIPITATION CHEMISTRY INTERCOMPARISON - 1994

		Deviations from "true values" in %				
LABORATORIES	**SAMPLE No.**	**Cd**	**Pb**	**Zn**	**Cu**	**Ni**
1	5 4	+ 1150 + 733	+ 52 + 2	- 3.2 - 21	- 58 - 65	+ 213 + 127
2	5 4	0 0	- 14 - 4.1	- 6.5 - 7	- 4.2 - 4.2	+ 6.3 + 4.5
3	5 4	ND ND	ND ND	- 9.7 - 12	- 16 - 17	ND ND
4	5 4	0 0	- 3 + 10	+ 16 - 12	0 - 5.6	+ 6.3 + 18
5	5 4	ND ND	ND ND	- 68 - 12	- 79 - 72	ND ND
6	5 4	- 50 - 33	- 59 + 32	- 26 - 28	- 69 - 56	- 19 - 27
7	5 4	0 + 33	+ 1.5 - 4.1	- 6.5 - 5.3	0 0	0 - 4.5
True values (mg/l)	5 4	0.002 0.003	0.066 0.098	0.031 0.057	0.048 0.072	0.016 0.022

RECOMMENDATIONS ON INTERCOMPARISON AND QUALITY ASSURANCE

A. General Remarks

1. Regarding the need for increased participation in future laboratory intercomparison studies, it is recommended that:

   (a) WMO should send a letter to all National Co-ordinators for MED POL and the Meteorological Services in the region encouraging participation in the upcoming laboratory intercomparison;

   (b) WMO should consider paying some laboratories for the analysis of the intercomparison samples or providing other inducements such as committing to sending analysts from poor performing laboratories to training sessions.

2. It is recommended that the results of the first laboratory intercomparison study (for determination of heavy metals in exposed air filters) should be presented in a formal document (Mr S. Guerzoni and Mr G. Quarantotto).

3. It is recommended that the three poorest performing laboratories in the recent laboratory intercomparison study be given help in the form of training using MED POL funds. Training should be performed in an analytical centre of excellence (e.g. IAEA-MEL). Training for Hg measurements should also be envisaged.

4. MED POL should allocate funds to buy Certified Reference Materials (such as "urban dust" and "atmospheric particulates" and "Standard Rainwater Solutions") for laboratories involved in atmospheric monitoring.

5. It is recommended that a set of the Certified Reference Solutions (e.g. precipitation) be sent to each laboratory for analysis (if the cost is prohibitive, then stock solutions could be used). This is based on the fact that most laboratories in the first intercomparison performed better in extracting the filters than in the analysis. Depending on the outcome of this study, a second filter intercomparison study could be considered.

6. It is recommended that individual laboratories exchange partial filters as part of informal intercomparison studies.

7. It is recommended that a field intercomparison of samplers be carried out in two parts:

   (a) The Marine Geology Institute in Bologna, Italy, should conduct a high volume sampler intercomparison study using the new brushless (normal and isokinetic) samplers MTX type, the Sierra Andersen type, the Strohlein and the Aquaero types. All samples should be analyzed at that laboratory and the results considered in the light of instrument performance, reliability, contamination, leaks, flow stability and loadings;

   (b) An institute of suitable capability conducts a wet-only and bulk precipitation sampler intercomparison study at one location. All chemical analyses should be carried out at one laboratory and the results should be compared for reliability, collection efficiency, contamination and overall comparability.

8. It is recommended that an audit team be established to carry out performance audits at all MED POL sites. Particular attention should be paid to flow calibrations, contamination problems, etc.

9. All these activities should be coordinated by an existing Quality Assurance Centre (e.g. the GAW one).

B. Design of an Aerosol Sampling Intercomparison Study

10. The objective of the study will be to intercompare all aerosol samplers used in MED POL and two new brushless samplers designed by CNR, Italy (one normal and another isokinetic). The results will be used to:

(a) Document the comparability of historical aerosols data in terms of instrument performance;

(b) Produce recommendations on a standard instrument(s) for the MED POL programme. Note: this study will only address instrument comparability, not overall measurement comparability of aerosol chemistry measurements;

(c) Include the results in the MED POL manual (in preparation).

11. The main problems related to high volume aerosol sampling that justify the need for such a comparison can be summarized as follows:

i) contamination (brushes, filter holder, cover),
ii) flow rate recording,
iii) duration of the motor operation,
iv) sampling efficiency (non isokinetic).

Proposed activity

12. (a) The study should be carried out for one month, in Sardinia, and would produce at least 20 daily samples for comparison;

(b) One Hi-Vol sampler of each type used in the network should be purchased or borrowed and co-located at the study site. The Strohlein from Spain, the Aquaero from Malta, the Sierra Andersen from the host country (Italy). The two new MTX instruments,one from Italy (the isokinetic one) and another provided by WMO, should be located at the same site;

(c) The sample handling procedures and the sampling periods should be the same for all of the Hi-Vol collectors. The standard operating procedures defined in the manual should be followed exactly. Special attention should be given to the recommended period of checking the flow rate;

(d) Field blanks should be taken simultaneously one per week from each collector;

(e) Sampling length and total air filtered by each samplers should be recorded to assess their performance;

(f) A field technician should inspect the instruments daily and report on their respective performances, e.g. tightness of filter holders, presence of visible dirt on the cover, accuracy of the flow meters sensors, frequency of instrument breakdowns, unusual instrument problems;

(g) Data analysis, both quantitative and qualitative should be carried out by a suitable institution, ideally by the one that was responsible for the field measurements.

Sampling training (duration 3-5 days)

13. During the period of intercomparison one person per presently operational MED POL station will be trained in Sardina for all sampling phases listed above.

Each participant will bring the calibation kit and all equipment and instruments normally used to calibrate his own Hi-Vol sampler.

Expected results

14. The data analysis will focus on two conclusions:

(a) the comparability of the historical MED POL Hi-Vol aerosol data based on the instrument performance,

and

(b) the identification of a most suitable sampler(s) to be adopted for use in the MED POL programme.

15. The training will focus on:

(a) the comparison among different handling procedures;

(b) the homogenisation of calibration procedures;

C. Design of a Precipitation Intercomparison Study

16. The objective of the study will be to intercompare all wet-only collectors used in MED POL and one set of bulk collectors. The results will be used to:

(a) Assess the comparability of historical precipitation data in terms of instrument performance,

and

(b) Produce recommendations on a most suitable instrument(s) for the MED POL programme. Note: this study will only address instrument comparability, not overall comparability of precipitation chemistry measurements.

Proposed activity

17. (a) The study should be carried out for at least one year, at a site that would produce at least 30 daily samples for comparison;

(b) Wet-only samplers (each type used in the network) and a standard raingauge should be purchased or borrowed and co-located at the study site. At least, one bulk collector, presumably that of the host country, should be located at the same site;

(c) The sample handling procedures and the sampling periods should be the same for all of the wet-only collectors. The standard operating procedures defined in the manual should be followed exactly. Special attention should be given to the recommended period of changing the hood gaskets to test the ability of the samplers to prevent contamination during dry periods;

(d) Field blanks should be taken simultaneously one per week from each collector. The blanks should be taken after at least one dry day by pouring 50 ml of deionized water around the outside of the collection vessel (funnel, bucket). The resulting rinse solutions and a deionized water control sample should be analyzed. The results should be inspected to determine the quality of the hood seals;

(e) The opening and closing times of the samplers should be recorded to assess their sensitivity and performance;

(f) All samples should be analyzed at the laboratory of the host agency using identical techniques. Extra quality control samples should be included in the analytical runs including duplicate analyses and check solutions. Several times, during the year, certified rainwater standards should be analyzed in triplicate. All laboratory quality control results should be retained and passed along to the data analyst for the study;

(g) A field technician should inspect the instruments at least twice per week and report on their respective performances, e.g. tightness of hood seal, presence of visible dirt in the collection vessels during the dry periods, sensitivity of the sensors, frequency of instrument breakdowns, unusual instrument problems;

(h) Data analysis, both quantitative and qualitative, should be carried out by a suitable institution, ideally by the one that was responsible for the field measurements;

(i) The laboratory chosen to carry out the chemical analyses should have demonstrated capabilities with ion chromotographs, AAs and pH meters.

Expected results

18. The data analysis will focus on two conclusions:

(a) the comparability of the historical MED POL precipitation data based on the instrument performance,

and

(b) the identification of a most suitable rain sampler(s) to be adopted for use in the MED POL programme.

19. It is recommended that WMO find a suitable candidate to evaluate the results of the MED POL laboratories who participated in the recent GAW and EMEP laboratory intercomparison studies. Those laboratories that did not perform well should be identified and their analysts sent for training at the IAEA laboratory, Monaco or another institute.

D. Quality Assurance Programme - Future Planning

Introduction

20. A comprehensive Quality Assurance programme needs to be developed and instituted in the MED POL programme over the next several years. A lead agency should be chosen to carry out this task and be given a dedicated budget to do so. This could follow the example of the WMO Global Atmosphere Watch which has selected lead agencies to develop and operate Quality Assurance/Science Activity Centres for Europe and Africa, the Americas and the Far East. The lead QA/QC agency should address the following quality assurance activities:

(a) Quality Assurance Objectives;
(b) Programme Organization and Management;
(c) Siting;
(d) Instrumentation Quality Control (i.e. Procurement, Acceptance Testing, Calibration, Preventive Maintenance, Corrective Action, Audits);
(e) Sample Collection and Handling Quality Control;
(f) Sample Shipping;

(g) Laboratory QA/QC (e.g. Sample Custody, Sample Preparation and Storage, Method Selection and Definition, Analyst Training, Internal and External Quality Control Procedures);
(h) Data Management QC (e.g. Data Entry, Data Screening, Reporting);
(i) Documentation and Document Control;
(j) Sample and Data Custody;
(k) Training and Upgrading;
(l) Corrective Action;
(m) Routine and Non-routine Procedures for the Assessment of Accuracy, Precision, Completeness, Representativeness and Comparability;
(n) Audits;
(o) Special Studies;
(p) Quality Assurance Reporting.

Given the difficulties in allocating funds for such an activity, it is recommended that the MED POL programme institutes a multi-year plan to address the most important QA/QC procedures. Individual MED POL countries with specific expertise should be asked to take on the responsibility for selected components of the QA programme. It is also recommended that WMO approach the IAEA Laboratories in Monaco and the Fraunhofer Institute of Air Research in Germany to accept responsibility for certain components of the MED POL QA programme as an extension to their current QA work being carried out for the GAW programme.

Proposed QA Programme

21. The recommended implementation of the QA programme is as follows;

1995 - Distribute heavy metal and major ion Certified Reference Solutions to all participating laboratories;

- Identify those laboratories which have performed poorly in laboratory intercomparison studies and send their analysts for training at the IAEA Laboratory in Monaco or another appropriate institute;

- Carry out a field intercomparison study for the aerosol samplers being used in the MED POL programme;

- Based on the results of this afore-mentioned intercomparison study, recommend a standard aerosol sampler(s) for use in the programme and define standard operating procedures for aerosol sampling;

- Define the Quality Assurance objectives of the progamme and the Data Quality Objectives of the measurements (i.e. accuracy, precision, comparability, completeness and representativeness);

1996 - Carry out a field intercomparison study of all wet-only precipitation chemistry samplers being used in MED POL;

- Based on the results of this study, recommend a standard precipitation sampler(s) for use in the programme. Define standard operating procedures for the collector;

- Develop a Quality Assurance Plan and begin implementation of the QA programme;

- Carry out performance audits at all field sampling sites focusing on flow calibrations, instrument repair and training of technical staff;

- Continue with the annual participation of MED POL laboratories in EMEP and GAW laboratory intercomparison studies. Also continue with the distribution of certified standards to all laboratories;

- Carry out a second filter laboratory intercomparison study if deemed necessary from the analyses of the certified solutions;

- Based on the results of the intercomparison studies, continue to send the staff of poor-performing laboratories to training sessions;

1997 - Install the recommended standard aerosol and precipitation collectors at all sites;

- Carry out training sessions for field technicians on the calibration and maintenance of the standard aerosol and precipitation samplers;

- Continue with the site audit programme;

- Institute a system of laboratory audits (or training sessions) designed to check the internal quality control procedures of the laboratories;

- Define a recommended set of data quality control procedures and apply them to the data base;

1998 - Continue with laboratory intercomparison studies, the distribution of certified standards, the field and laboratory audits and the training programmes;

- Install and operate duplicate sampling instruments at several sites for the purpose of defining overall measurement precision;

- Produce a quality assurance report defining accuracy, precision, completeness, representativeness and comparability of the MED POL atmospheric measurements.

Conclusions

22. The foregoing QA programme would require that individual countries accept the lead responsibility for specific components of the Quality Assurance programme. The long-term implementation of this programme will enhance the credibility of MED POL data in the following critical ways:

(a) It will lead to the assessment and implementation of standard sampling instruments and operating procedures;

(b) It will ensure the continued identification of good, satisfactory and poorly-performing laboratories and will correct the latter through training programmes;

(c) It will ensure that all laboratories are working with similar certified standards;

(d) It will ensure that proper calibrations and maintenance are being carried out on the sampling instruments at all sites;

(e) It will ensure that data quality control is addressed and that measurements of precision, relative accuracy and comparability are considered.

ANNEX VIII

DATA REPORTING FORMATS AND PARAMETERS

Table 1. DATA TRANSFER FORMATS AND CODES

STATION TYPES	
Type Code	**Description**
A	Atmospheric Reference (Background)
B	Bathing (Recreational)
C	Coastal General
E	Estuarine
H	Hot Spot (Affected by pollution)
M	Market (Samples taken from local market)
R	Reference/Offshore
S	Sources of Pollution (Effluent)
X	Unclassified Station Type
I	Atmospheric Impact (Hot Spot)

Table 2.

MONITORING FREQUENCIES		
Frequency Code	**Number of Samplings**	**Description**
X		Irregular-Number to follow
E		On an event basis
Y	1	Yearly (annually)
S	2	Six-monthly (semi-annually)
Q	4	Quartely (seasonal)
B	6	Bimonthly
M	12	Monthly
F	24	Fortnightly (twice a month)
W	52	Weekly
D	365	Daily
H	8760	Hourly
C	9999	Continuously

Table 3. AIR

Seq. No.	Column Name	Requisite?	Description	Column Type/Length
	Area & Station Information			
1	YEAR	YES	Monitoring year (Format is XX for 19XX)	NUM (2)
2	COUNTRY	YES	Monitoring country code (See country list, Appendix I)	CHAR (3)
3	AREA CODE	YES	Monitoring area code	CHAR (6)
4	AREA DESCRIPTION	-	Monitoring area description	CHAR (30)
5	STATION CODE	YES	Monitoring station code	CHAR (6)
6	STATION DESCRIPTION	-	Monitoring station description	CHAR (30)
7	STATION TYPE	YES	Station type code (Reference or Impact, See Volume 1, CODES)	CHAR (1)
8	HEIGHT	YES	Height of station from the ground in metres (Format is 999.9)	NUM (5,1)
9	ALTITUDE/ELEVATION	YES	Altitude/Elevation of the station ground level, above sea level in meters (Format is 9999.9)	NUM (6,1)
10	DISTANCE TO SHORE	-	Distance to shore in meters (Format is 99999.9)	NUM (7,1)
11	METEO. STATION DISTANCE	YES	Distance to the nearest meteorological station in meters (Format is 99999.9)	NUM (7,1)
12	LATITUDE DEGREE	YES	Latitude degree (station coordinate - applies to Seq. Nos. 12-19)	NUM (2)
13	LATITUDE MINUTE	YES	Latitude minute coordinate	NUM (2)
14	LATITUDE SECOND	YES	Latitude second coordinate	NUM (2)
15	LATITUDE HEMISPHERE	YES	Latitude hemisphere (Code N=North, S=South)	CHAR (1)
16	LONGITUDE DEGREE	YES	Longitude degree coordinate	NUM (3)
17	LONGITUDE MINUTE	YES	Longitude minute coordinate	NUM (2)
18	LONGITUDE SECOND	YES	Longitude second coordinate	NUM (2)
19	LONGITUDE HEMISPHERE	YES	Longitude hemisphere (Code W=West, E=East)	CHAR (1)
20	SAMPLER(S)	-	Sampler information	CHAR (20)
21	FILTER(S)	-	Filter information	CHAR (20)

Seq. No.	Column Name	Requisite?	Description	Column Type/Length
			Sampling Information	
22	SAMPLE NUMBER	YES	Sample number	NUM (3)
23	SAMPLING START DATE	YES	Sampling start date	DATE
24	SAMPLING START HOUR	YES	Sampling start hour (00 to 23)	NUM (2)
25	SAMPLING START MINUTE	YES	Sampling start minute (00 to 59)	NUM (2)
26	SAMPLING END DATE	YES	Sampling end date	DATE
27	SAMPLING END HOUR	YES	Sampling end hour (00 to 23)	NUM (2)
28	SAMPLING END MINUTE	YES	Sampling end minute (00 to 59)	NUM (2)
29	AVERAGE AIR TEMPERATURE	-	Average air temperature during sampling, in Celcius (Format is 99.99)	NUM (5,2)
30	AVERAGE RELATIVE HUMIDITY	-	Average relative humidity during sampling, in percentage (Format is 99.99)	NUM (5,2)
31	AVERAGE ATMOSPHERIC PRESSURE	-	Average atmospheric pressure during sampling, in hPa (Format is 9999.99)	NUM (7,2)
32	AIR VOLUME	-	Sampled air volume, in cubic meters (Format is 9999.999)	NUM (8,3)
33	PREVAILING WIND DIRECTION	-	Prevailing wind direction during sampling, in compass degrees	NUM (3)
34	AVERAGE WIND SPEED	-	Average wind speed during sampling, in m/sec (Format is 9.99)	NUM (4,2)
35	OBSERVATION	-	Observational remarks	CHAR (30)
36	SAMPLING INST CODE	-	Sampling institute code (See Supplementary Data chapter for clarification)	NUM (2)
			Parameter Analysis Information	
37	PARAMETER	YES	Airborne pollution parameter code (See Volume 1, CODES)	CHAR (5)
38	NA	-	Number of parameter analysis	NUM (2)
39	CONCENTRATION	YES	Concentration in scientific format (9.99999E99, see Volume 1, CODES for units)	CHAR (10)
40	BDL	-	If concentration is below detection limit, BL should be entered	CHAR (2)
41	STD	-	Standard deviation if more than one analysis is made (9.99999E99, see Volume 1, CODES for units)	CHAR (10)
42	ANALYSIS METHOD	-	Method used (See Volume 1, CODES)	CHAR (5)
43	ANALYSIS DATE	-	Date of analysis	DATE
44	ANALYZING INST CODE	-	Analyzing institute code (See Supplementary Data chapter for clarification)	NUM (2)

Table 4. PRECIPITATION

Seq. No.	Column Name	Requisite?	Description	Column Type/Length
			Area & Station Information	
1	YEAR	YES	Monitoring year (Format is XX for 19XX)	NUM (2)
2	COUNTRY	YES	Monitoring country code (See country list, Appendix I)	CHAR (3)
3	AREA CODE	YES	Monitoring area code	CHAR (6)
4	AREA DESCRIPTION	-	Monitoring area description	CHAR (30)
5	STATION CODE	YES	Monitoring station code	CHAR (6)
6	STATION DESCRIPTION	-	Monitoring station description	CHAR (30)
7	STATION TYPE	YES	Station type code (Reference or Impact, see Volume 1, CODES)	CHAR (1)
8	HEIGHT	YES	Height of station from the ground in metres (Format is 999.9)	NUM (5,1)
9	ALTITUDE/ELEVATION	YES	Altitude/Elevation of the station ground level, above sea level in meters (Format is 9999.9)	NUM (6,1)
10	DISTANCE TO SHORE	-	Distance to shore in meters (Format is 99999.9)	NUM (7,1)
11	METEO. STATION DISTANCE	YES	Distance to the nearest meteorological station in meters (Format is 99999.9)	NUM (7,1)
12	LATITUDE DEGREE	YES	Latitude degree (station coordinate - applies to Seq. Nos. 12-19)	NUM (2)
13	LATITUDE MINUTE	YES	Latitude minute coordinate	NUM (2)
14	LATITUDE SECOND	YES	Latitude second coordinate	NUM (2)
15	LATITUDE HEMISPHERE	YES	Latitude hemisphere (Code N=North, S=South)	CHAR (1)
16	LONGITUDE DEGREE	YES	Longitude degree coordinate	NUM (3)
17	LONGITUDE MINUTE	YES	Longitude minute coordinate	NUM (2)
18	LONGITUDE SECOND	YES	Longitude second coordinate	NUM (2)
19	LONGITUDE HEMISPHERE	YES	Longitude hemisphere (Code W=West, E=East)	CHAR (1)
20	SAMPLER(S)	-	Sampler information	CHAR (20)
21	FILTER(S)	-	Filter information	CHAR (20)

Seq. No.	Column Name	Requisite?	Description	Column Type/Length
			Sampling Information	
22	SAMPLE NUMBER	YES	Sample number	NUM (3)
23	SAMPLING START DATE	YES	Sampling start date	DATE
24	SAMPLING START HOUR	YES	Sampling start hour (00 to 23)	NUM (2)
25	SAMPLING START MINUTE	YES	Sampling start minute (00 to 59)	NUM (2)
26	SAMPLING END DATE	YES	Sampling end date	DATE
27	SAMPLING END HOUR	YES	Sampling end hour (00 to 23)	NUM (2)
28	SAMPLING END MINUTE	YES	Sampling end minute (00 to 59)	NUM (2)
29	EVENTS	-	Number of events (Format is 99)	NUM (2)
30	PRECIPITATION-NG	YES	Precipitation (National Gauge) in mm	NUM (5)
31	PRECIPITATION-SG	-	Precipitation (Sampling Gauge) in mm	NUM (5)
32	OBSERVATION	-	Observational remarks	CHAR (30)
33	SAMPLING INST CODE	-	Sampling institute code (See Supplementary Data chapter for clarification)	NUM (2)
			Parameter Analysis Information	
34	PARAMETER	YES	Precipitation pollution parameter code (See Volume 1, CODES)	CHAR (5)
35	NA	-	Number of parameter analysis	NUM (2)
36	CONCENTRATION	YES	Concentration in scientific format (9.99999E99, see Volume 1, CODES for units)	CHAR (10)
37	BDL	-	If concentration is below detection limit, BL should be entered	CHAR (2)
38	ANALYSIS METHOD	-	Method used (See Volume 1, CODES)	CHAR (5)
39	ANALYSIS DATE	-	Date of analysis	DATE
40	ANALYZING INST CODE	-	Analyzing institute code (See Supplementary Data chapter for clarification)	NUM (2)

Table 5.

MED POL PARAMETERS FOR AIR & PRECIPITATION			
Parameter Code in MED POL Database	**Description**	**Units of Measurement in Matrices**	
		Air	**Precipitation**
ACID	Acidity	x	µeq/L
AG	Silver	ng/m3	x
AIRV	Air Volume	m3	x
AL	Aluminium	ng/m3	µg/L
ALKA	Alkalinity	x	µeq/L
AS	Arsenic	ng/m3	µg/L
CA	Calcium	ng/m3	µg/L
CACO3	Calcium Carbonate	x	µg/L
CD	Cadmium	ng/m3	µg/L
CL	Chlorides/Chlorine	ng/m3	µg/L
CO	Cobalt	ng/m3	µg/L
CO1	Carbon Monoxide	ppm	x
CO2	Carbon Dioxide	ppm	x
CONDU	Conductivity	x	µS/cm
CR	Chromium	ng/m3	µg/L
CU	Copper	ng/m3	µg/L
DDD	opDDD + ppDDD	pg/m3	pg/L
DDDO	Dichloro-Diphenyl Dichloroethane op (same as TDEO)	pg/m3	pg/L
DDDP	Dichloro-Diphenyl Dichloroethane pp (same as TDEP)	pg/m3	pg/L
DDE	opDDE + ppDDE	pg/m3	pg/L
DDEO	Dichloro-Diphenyl Dichloroethene op	pg/m3	pg/L
DDEP	Dichloro-Diphenyl Dichloroethene pp	pg/m3	pg/L
DDT	opDDT + ppDDT	pg/m3	pg/L
DDTO	Dichloro-Diphenyl Trichloroethane op	pg/m3	pg/L
DDTP	Dichloro-Diphenyl Trichloroethane pp	pg/m3	pg/L
DDTS	opDDT + ppDDT + opDDE + ppDDE + opDDD + ppDDD	pg/m3	pg/L
DIE	Dieldrin	pg/m3	pg/L
F	Fluorides/Fluorine	x	µg/L
FE	Iron	ng/m3	µg/L
HCB	Hexachlorobenzene	pg/m3	pg/L
HCH	Hexachlorohexane (same as BHC) (excluding Lindane)	pg/m3	pg/L
HGT	Total Mercury	ng/m3	µg/L
K	Potassium	ng/m3	µg/L
MG	Magnesium	ng/m3	µg/L
MN	Manganese	ng/m3	µg/L
MO	Molybdenum	ng/m3	µg/L
NA	Sodium	ng/m3	µg/L
NH3-N	Ammonia reported as nitrogen	µg/m3	µg/L
NH4	Ammonium	x	µg/L
NH4-N	Ammonium reported as nitrogen	µg/m3	µg/L

MED POL PARAMETERS FOR AIR & PRECIPITATION			
Parameter Code in MED POL Database	Description	Units of Measurement in Matrices	
		Air	Precipitation
NI	Nickel	ng/m3	µg/L
NO2	Nitrites	x	µg/L
NO3	Nitrates	µg/m3	µg/L
NO3-2	Nitrates+Nitrites	x	µg/L
NO3-N	Nitrates reported as nitrogen	µg/m3	µg/L
NOX	Nitrogen Oxides	ppb	x
O3	Ozone	ppb	x
PB	Lead	ng/m3	µg/L
PCBA	Polychlorinated Biphenyls (as Arochlor 1254)	pg/m3	pg/L
PCBB	Polychlorinated Biphenyls (as Arochlor 1260)	pg/m3	pg/L
SE	Selenium	ng/m3	µg/L
SO2	Sulphur Dioxide	ppb	x
SO4-S	Sulphates reported as sulphur	µg/m3	µg/L
SPM	Total suspended particulate matter	µg/m3	x
V	Vanadium	ng/m3	µg/L
ZN	Zinc	ng/m3	µg/L

MONITORING, MODELLING, ASSESSMENT AND CONTROL OF POLLUTION OF THE MEDITERRANEAN SEA THROUGH THE ATMOSPHERE:

PROPOSALS FOR MED POL - Phase III (1996-2005)

1. OVERALL OBJECTIVES AND BASIC PRINCIPLES

The overall objectives of this programme is to assess airborne pollution levels and atmospheric inputs of environmentally important pollutants into the Mediterranean Sea at regional and sub-regional levels and to assist Mediterranean Governments in conducting similar assessments at the national and local levels.

The programme will consists of two components:

(a) a co-operative regional programme which will be a part of the baseline studies and of the regional assessment of the state of the Mediterranean marine environment, under which reference monitoring stations are operated, and

(b) co-ordinate national monitoring and assessment programmes in coastal areas, under which impact monitoring stations are operated.

The programme proposed for the MED POL-Phase III airborne pollution component reflects the following two important facts:

(a) a substantial fraction of the contamination entering the Mediterranean sea (for some contaminants, more than 50%) derives from sources located on land via the atmospheric inputs, as the results obtained from the airborne pollution monitoring and research in the MED POL-Phase II have shown;

(b) at the MED POL-Phase II, a number of monitoring stations were established and provided valuable data for a preliminary assessment, and some of the main objectives of MED POL-Phase III should be to ensure the continuation of the monitoring activity of the existing stations, to establish new monitoring stations required to cover adequately the whole Mediterranean Region, particularly its southern coast, and to ensure regular data reporting.

2. REFERENCE MONITORING PROGRAMME AND ASSESSMENTS

2.1 Basic principles

Assessment of airborne pollution of the Mediterranean Sea should be based on data derived from monitoring stations providing reference levels of pollution in the area, as well as on the reliable and well-calibrated model results.

The Contracting Parties to the Barcelona Convention (if necessary with partial financial support from the Mediterranean Trust Fund) should ensure continuous and long-term operation of their monitoring stations as an indispensable prerequisite for regional airborne pollution assessments and development of pollution control measures.

2.2 Objectives

The main objectives of the programme are:

- to assess airborne pollution of the Mediterranean Sea and its sub-regions;
- to identify long-distance area sources of airborne pollution;

- to provide scientific rationale for formulation of regional measures to protect the sea against pollution through the atmosphere;

- to monitor the trends of airborne pollution levels and inputs to evaluate the compliance with the adopted control measures;

- to ensure the required quality of monitoring data; and

- to promote the increased involvement of national institutions in the programme through direct assistance, training and advisory expert missions.

The monitoring will be based on the work of national research centres and monitoring stations which shall constitute a regional network operating in accordance with agreed procedures and protocols.

2.3 Measurement programmes

Measurements related to the regional monitoring programme should be conducted at reference stations established by participating countries. A station is designated as "reference station" if it fulfills the following conditions:

- stations should be within 10 km from the shoreline,
- major pollution sources (such as power stations, cities with population more than 10,000 etc.) should be at distances greater than 10 km,
- the site should be at least 1 km from major roads, land-fills and small towns (with population of 1,000.

Two types of monitoring programmes can be performed at the reference stations:

- basic programme
- extended programme

The basic programme is performed to assess airborne pollution of the Mediterranean Sea and its sub-regions, to monitor the trends of airborne pollution levels and inputs using simplest possible sampling techniques.

The extended programme is performed to assess airborne pollution of the Mediterranean Sea and its sub-regions, to monitor the trends of airborne pollution levels and inputs and to provide scientific rationale for the formulation of regional pollution control measures and to identify source areas and types contributing to the airborne pollution of the Mediterranean basin.

The two programmes differ in both the complexity of the instrumentation needed and manpower allocation. The basic programme can be accomplished by allocating the minimum man power and relatively inexpensive instruments, while the extended programme requires staffed stations and more sophisticated instrumentation. Parameters measured in both programmes are the same.

Countries participating in the airborne pollution monitoring programme are expected to conduct the basic programme; however, the extended programme should be performed whenever means and facilities are available, because data generated in the extended programme can be used to determine the regulatory actions necessary to reduce the airborne pollution of the Mediterranean Sea.

The following protocols should be used in the **basic programme:**

Deposition

Sampling type: Bulk
Sampling time: Two weeks

Parameters to be measured:
Major ions (pH, conductivity, acidity, SO_4, NO_3, NH_4, Cl, Na, K, Mg, Ca)
Metals (Cd, Pb, Cu, Zn)

Aerosol

Sampling type: High-volume
Sampling time: One week
Parameters to be measured:
Major ions (SO_4, NO_3, NH_4, Cl, Na, K, Mg, Ca)
Metals (Cd, Pb, Cu, Zn)
Meteorological parameters (average wind speed, wind direction, air temperature, relative humidity, barometric pressure)

The following protocols should be used in the **extended programme:**

Deposition

Sampling type: Wet and dry or wet-only and bulk
Sampling time:
Wet and dry: wet-24 hrs, dry-7 days
Wet-only and bulk: wet-only 24 hours, bulk-7 days.
Parameters to be measured:
Major ions (pH, conductivity, acidity, SO_4, NO_3, NH_4, Cl, Na, K, Mg, Ca)
Metals (Cd, Pb, Cu, Zn, Hg)[1]

Aerosol

Sampling type: High-volume and high-volume cascade impactor
Sampling time:
Whole filter: 24 hours
Impactor: 7 days

Parameters to be measured (both in whole filter and impactor sampling):
Major ions (SO_4, NO_3, NH_4, Cl, Na, K, Mg, Ca)
Metals (Cd, Pb, Cu, Zn, Al, Hg)[2]
Meteorological parameters (average wind speed, wind direction, air temperature, relative humidity, barometric pressure)

2.4 Data quality assurance (QA) and quality control (QC)

A comprehensive Quality Assurance programme needs to be developed and instituted in the MED POL programme over the next several years. Ideally, a lead agency should be chosen to carry out this task and be given a dedicated budget to do so.

It is recommended that the MED POL programme institute a multi-year plan to address the most important QA/QC procedures. Individual MED POL countries with specific expertise should be asked to take on the responsibility for selected components of the QA programme. It is also recommended that WMO approach the IAEA Laboratories in Monaco and Fraunhofer Institute in Germany to accept responsibility for certain components of the QA programme as extension to their QA work being carried out for the MED POL and the WMO Global Atmosphere Watch (GAW) programmes respectively. The obligations to participate in all QA activities should be included in all the national monitoring agreements as a prerequisite for any financial assistance.

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[1] Measurement of metals are not expected in dry-deposition samples

[2] As, Se and V should be measured whenever possible

2.5 Data reporting

In accordance with the agreed procedures and formats, all the monitoring data from the regional stations should be regularly reported to the MED Unit and WMO and be available for the regional assessments. Data transfer will be done both as hard copy and on magnetic media. The format of the data on the magnetic media should be compatible with the data base format agreed by the participating institutes and set up in the MED Unit.

2.6 Modelling and assessments

The assessment of the total input of pollutants to the Mediterranean Sea and its sub-regions through the atmosphere, its trends and seasonal variations, and contributions of individual countries will be made by means of modelling of atmospheric transport and deposition of pollutants using the current meteorological information and emission data. The results of monitoring will be used for verification of model calculation.

The data on emissions of pollutants into the atmosphere will be collected on the basis of agreed procedures such as the CORINAIR system and should be available for regional assessments.

It would be expedient if an institution that has experience in regional air pollution modelling be designated to carry out the modelling for the whole region. The use of expertise and assistance of modelling centres existing within other international programmes (e.g. EMEP) will be of benefit and close cooperation with these programmes should be established.

In addition to the assessment of depositions of airborne pollutants on the Mediterranean Sea, the modelling should also be used to:

- evaluate transboundary air pollution of every Mediterranean country from adjacent countries and other regions;
- estimate depositions of airborne pollutants on the Mediterranean Sea watershed and their run-off from the watershed to the sea;
- provide information on seasonal variations and spatial distribution of depositions on regional and sub-regional scale;
- develop optimal cost-benefit abatement strategies for emission reductions for the region and thus for reduction of pollution of the sea through the atmosphere; and
- provide information on compliance with the adopted regional measures concerning reduction of airborne pollution of the sea.

2.7 Programme co-ordination

The programme shall be co-ordinated by the MED Unit (directly or through an appropriate international organization) and by a group of experts nominated by countries which should meet regularly. For the terms of reference of this group of experts see Appendix I.

3. IMPACT MONITORING PROGRAMMES AND ASSESSMENTS

3.1 Objectives and basic principles

The main objectives of the impact programmes shall be:

- to assess airborne pollution of the coastal areas;
- to monitor airborne pollution levels and inputs to the coastal areas from major national single and multiple sources;

- to develop mesoscale air pollution dispersion models for forecasting and regulating airborne pollution of coastal areas and for optimizing location of pollution sources.

Impact monitoring and modelling will be carried out by national institutions as a part of the national air pollution control programmes and taking into account the recommendations of the reference airborne pollution monitoring and assessment programme.

3.2 Measurement programmes

A station is designated as a "source-impacted" station if it does not fulfill the requirements given in section 2.3 for the reference station. Since impact stations are located relatively close to individual sources or source areas, pollutant concentrations and deposition measured would provide information on the effect of these source areas in the near marine environment.

The sampling protocols used in the source-impacted stations should be identical with the sampling protocols used in the reference stations. However, if a region around an impacted station is an important source of a pollutant or pollutants which are not measured in the reference stations, that particular parameter should be added to the sampling and analysis protocol.

3.3 Modelling and assessment

The assessment of inputs of pollutants to the coastal areas through the atmosphere from major national single and multiple sources will be made by applying meso-scale air pollution dispersion and deposition models using the current meteorological information and emission data. It would be expedient if a suitable institute in each country would design and carry out modelling on the national scale. Results of this model should also serve for comparison and verification of the regional models (see paragraph 2.6) and should be included in them by "nesting" procedures.

3.4 Application and reporting of results

Only monthly average assessments of atmospheric inputs of pollutants into the coastal areas shall be reported to the MED Unit to be used for regional assessments.

More detailed information generated by the national monitoring and modelling programmes will be used for national pollution control measures to protect the environment in the coastal areas.

3.5 Programme co-ordination

The national programmes shall be co-ordinated by national institutions. General information about implementation of national monitoring and assessment programmes and air pollution control measures shall be submitted to the MED Unit for overall co-ordination of these activities.

4. CAPACITY BUILDING

The development of national capabilities and capacities for carrying out the monitoring and assessment of atmospheric inputs of pollutants into the Mediterranean Sea, on regional, sub-regional, national and local scales, should be one of the major objectives of the programme. That could be achieved through training of national personnel and fellowships as well as by direct assistance to the national monitoring and assessment activities and by advisory expert missions. Transfer of technical know-how should also be sought through bilateral and multilateral co-operation.

5. RESEARCH

5.1 *Basic principles*

Both regional and national airborne pollution monitoring and assessment programmes should be accompanied by research activities as a part of the MED POL research area II

"Transport and dispersion of pollutants". Only research and studies directly relevant to the achievements of the objectives of MED POL - Phase III and its components shall be considered as MED POL - Phase III research projects.

Research and studies will be carried out by Mediterranean research centres and organizations primarily on a direct contractual basis or as a contribution from centres and organizations offered by the Contracting Parties.

Joint research cruises in the sea and aircraft experiment could provide valuable information in addition to the monitoring data. The MED Unit should be requested to explore any possibility to organize such joint experiments with participation of scientists from several countries who plan or may wish to conduct such experiments in the Mediterranean.

The research projects shall be co-ordinated by the Med Unit (directly or through a co-operating international organization) and by a MED POL group of experts on airborne pollution.

5.2 Objectives

The main objectives of the research and studies are the following:

- to promote research and studies related to the airborne pollution of the Mediterranean Sea in participating countries;
- to study and to parameterize the pollutant transformation and deposition processes in the atmosphere;
- to develop atmospheric pollutant transport, dispersion and deposition models for various space scales to be used for regional and national assessment of airborne inputs;
- to study the air-sea exchange of pollutants;
- to develop sampling and analytical techniques and quality assurance procedures;
- to develop methods for assessing emissions of pollutants into the atmosphere; and
- to promote the application of air pollution control measures within the Mediterranean region.

6. FORMULATION AND IMPLEMENTATION OF AIRBORNE POLLUTION CONTROL MEASURES

The results of the reference and impact airborne pollution monitoring and assessment programmes will be used for formulation of regional airborne pollution control measures which should be agree upon and adopted by the Contracting Parties for implementation.

The national measures to control airborne pollution of the coastal areas shall be formulated and implemented by respective national authorities taking into account the adopted regional control measures and national conditions. Annual reports on the implementation of national air pollution control measures shall be submitted to the MED Unit.

National reports on the implementation of the adopted control measures and regional airborne pollution trend monitoring will be used for evaluating the compliance with these regional control measures.

APPENDIX I

TERMS OF REFERENCE OF THE EXPERT GROUP ON AIRBORNE POLLUTION OF THE MEDITERRANEAN SEA

A. To co-ordinate and to guide the airborne pollution monitoring and modelling in the participating countries, and in particular:

- to recommend suitable and reliable sampling and analytical procedures paying due attention to the need for periodic intercalibrations and intercomparisons to ensure high quality of the collected data;

- to analyze monitoring data submitted by participating institutions and evaluate their quality;

- to encourage the development, intercomparison and application of appropriate models for constructing deposition fields, evaluating the origin of airborne pollutants and for applying these models for the development of pollution control measures;

B. To recommend methodologies for collecting emission data in the Mediterranean countries and emission data reporting procedures and promote the emission inventories;

C. To co-ordinate preparation of periodic assessment of pollution of the Mediterranean Sea through the atmosphere;

D. To advise the Contracting Parties to the Barcelona Convention on matters related to airborne pollution of the Mediterranean Sea Area, especially on the need for measures to reduce the pollution of the Sea, arising from emissions to the atmosphere;

E. To establish and maintain close co-operation with other relevant international programmes and organizations concerned with long-range and transboundary airborne pollution and to promote collaboration of the national institutes in the Mediterranean region in this field;

F. To report on its activities to the Scientific and Technical Committee for MED POL.