**UNITED NATIONS**

**E**

**Economic and Social Council**

Distr.
GENERAL

EB.AIR/GE.1/1998/3/Rev.1*
5 November 1998

ENGLISH ONLY

ECONOMIC COMMISSION FOR EUROPE

EXECUTIVE BODY FOR THE CONVENTION ON
LONG-RANGE TRANSBOUNDARY AIR POLLUTION

Steering Body to the Cooperative Programme
for Monitoring and Evaluation of the Long-range
Transmission of Air Pollutants in Europe (EMEP)
(Twenty-second session, Geneva, 7-9 September 1998)
(Item 4 of the provisional agenda)

# VISIONS FOR THE EMEP WORK BY 2005/2010 SEVENTH-PHASE PROGRAMME (1999-2001)

A note by the Chairman, prepared with the assistance of the secretariat



GE.98-32574

* For technical reasons the English version has been reissued. This version includes the amendment to paragraph 18 made by the Steering Body at its twenty-second session.

**Summary**

The international commitment to reducing acidification, caused in particular by the long-range transport of sulphur compounds, was the driving force behind the adoption of the Convention on Long-range Transboundary Air Pollution in 1979. In 2000, EMEP will have at its disposal time series of emissions and monitoring and modelling results of the acidifying pollutants spanning 20 years. This, together with some more recent data on photochemical oxidants and their precursors and on heavy metals and persistent organic pollutants (POPs), forms a good basis form a good basis for evaluating the development of the long-range transport of air pollutants and their loads in our ecosystems. It is also a basis for assessing the achievements of the international work, the Convention and its protocols and, together with effect-related data, for considering further abatement strategies and priorities. It is proposed that, through its seventh phase, EMEP should continue to provide the scientific underpinning of the work programme of the Convention. With the agreement on the revised NOx protocol, probably in 1999, the initial list of pollutants addressed by the Convention will be complete. The nature of the EMEP work will change to give more emphasis to demonstrating environmental improvements arising from the protocols. This will require, among other things, the next phase of EMEP to change its emphasis from a compartmentalized approach focusing on reports and analyses of the individual EMEP centres to a more integrated approach addressing subjects and issues of importance to the Convention and involving the work of two or more centres. This means that the EMEP centres will need to work in a more integrated and collaborative way, as well as increase their cooperation and interaction with national experts, other research groups and scientists studying the effects of air pollutants. The long-range transport of fine particles will be studied for the first time.

## I. VISIONS FOR THE EMEP WORK BY 2005/2010

1. The main objective of the EMEP programme is to provide the ECE Governments and the Convention on Long-range Transboundary Air Pollution with regular information on past and predicted emissions and concentrations and/or depositions of air pollutants in the EMEP region and, in particular, on the quantity and significance of their long-range transport. Its information on the relative importance of national and external emissions will help national authorities estimate their local and regional targets. EMEP results also form a basis for further evaluating international abatement strategies and for reviewing the implementation of the international protocols on emission reductions and compliance by Parties with their obligations.

2. It has always been a basic principle within the Convention that the protocols, and the Convention itself, as well as their implementation, should be based on the best possible scientific information. This will become increasingly important as further emission reductions become more difficult, and as the Convention covers new pollutants. It will be more important than ever before that EMEP should continue to provide the best scientific work, by recruiting and retaining high-calibre scientists, and maintaining its links with the most advanced scientific research. Indeed, as atmospheric problems become more complex and resource-intensive, there will be a need to interact with, and draw on the results of, other research programmes in Europe and North America. Again, as European emissions of some pollutants decline, the importance of sources outside Europe will increase, and it will be necessary to continue to extend the horizons of EMEP's work beyond the immediate ECE European region.

3. The work of the Convention has reached a critical stage in that two new protocols have recently been adopted and a third one, the multi-pollutant, multi-effects (NOx) protocol, should be adoted shortly. There is therefore a substantial body of legislation in place and it is appropriate to consider the implications of this situation for the work of EMEP. In broad terms, this means that the emphasis of the work of EMEP is likely to shift from analyses underpinning new protocols to assessing the successes or failures of existing instruments and exploratory work on new substances. In fact, it could be argued that in the future the work of EMEP could be more important by demonstrating environmental improvements. The shift will not be total of course, but rather will be a change in balance of the work programme. This is in line with the overall assessment of the main tasks under the Convention in the medium- and long-term, as discussed at the fifteenth session of the Executive Body in 1997.

4. This shift in EMEP work will, in turn, lead to a greater need to consider topics as a whole, rather than to continue to formulate work plans and to report on that work, centre by centre, as in the past. This change in approach should result in EMEP providing syntheses of the scientific work in a form much more useful to the Executive Body. In terms of the formulation of the centres' work-plans (to be discussed in the paper on the work-plan rather than in this strategic paper), this will entail a higher degree of collaboration between centres, and also with research programmes outside EMEP.

5. As the number of protocols has increased and the scientific work underpinning them has become increasingly complex, pressures on limited budgets and resources will increase. Over the next phase of EMEP, prioritization of the work will be essential. One way of maximizing

limited resources is to increase cooperation with other programmes and scientific work in related areas. Continued cooperation on scientific issues with the European Union will be essential. It will also be necessary to build on, and improve, the existing links with the World Meteorological Organization (WMO), OSPARCOM/HELCOM and with EUROTRAC. Moreover, as emissions in Europe decrease, and as modelling of ozone (and POPs, heavy metals, and acidification) becomes increasingly global, there will be an increasing need for scientific outreach to North America and possibly even wider. As well as looking outwards, the EMEP programme should also look inwards and continue to emphasize the educational aspects of its work among its existing members and the development of improved measurement and laboratory practices. Measurement is fundamental to EMEP and the advances begun in the sixth phase with improved quality programmes should be continued with the goal of continuing standardization both between countries and at individual country level.

6. In summary, the main purpose and the objectives of the EMEP work as expressed in paragraph 1 above will not change during the next few years. As stated above, more emphasis will, however, be given to the quality of information and to problem-oriented analyses of the results produced through emission inventories, monitoring and modelling.

7. The emission database for the Convention at present includes annual emission data for sulphur compounds, nitrogen oxides, ammonia, volatile non-methane hydrocarbons, methane, carbon monoxide and carbon dioxide since 1980, and some emission or use data on selected heavy metals (HMs) and persistent organic pollutants (POPs) since 1990. The goal is that all gaps in the national emission data for annual totals and the eleven main sectors (SNAP level 1) in these time series will be covered using harmonized emission inventory methodologies as soon as possible and at the latest during the 2005 inventory. Furthermore, the programme aims to collect, starting from the 1990 data series, more detailed information on sub-sector emissions (SNAP level 2) to facilitate the monitoring of the implementation of the emission reduction protocols, which will be a key activity under the Convention in the new millennium. At the same time, methods to estimate emission projections in a harmonized way will be developed and, accordingly, applied for (2005)/2010/2015. More information about the emissions or use of HMs and POPs will be collected, taking into account the requirements of the relevant new protocols. The geographical distribution of emission data in 50 km x 50 km grids for agreed compounds will be collected for every five years. EMEP aims at having a full set of gridded data for national totals and the major source categories for every five years starting from 1980 and updates for the years in between, if necessary.

8. In 2000, EMEP will have available time series on monitoring of acidifying pollutants since the adoption of the Convention in 1979. EMEP will give high priority to a thorough analysis of the monitoring and modelling results of sulphur and nitrogen compounds and, consequently, participate actively in the overall assessment of the achievements of the Convention and its protocols. This evaluation would also provide input to the state of the environment report needed in 2001 for the preparation of the fifth Ministerial Conference "Environment for Europe" to be held in 2002. EMEP will actively continue to collect monitoring data on acidifying pollutants and photochemical oxidants. Data from other ongoing international and national programmes will also be collected to facilitate the overall assessment and, for instance, the verification of the photo-oxidant models. Using scientific and statistical methods, EMEP will evaluate the use of models also in areas with fewer monitoring stations. Based on the trends and overall evaluation of the monitoring and modelling results of the past 20 years, EMEP will consider the need for further continuous monitoring of acidifying pollutants, photochemical oxidants and related compounds using the present network. It will also study the possibilities for increasing monitoring in areas with no or hardly any stations, replacing in some parts of the region existing dense monitoring networks with fewer "super stations", and using these results together with models to produce information for the whole region to satisfy the needs of the Convention and its protocols. EMEP will also provide necessary information for the specific joint implementation agreements for the 1994 Protocol on Further Reduction of Sulphur Emissions, as requested.

9. The new protocols on heavy metals and persistent organic pollutants, which were adopted in June 1998, will, once in force, require EMEP to provide information on the long-range transport and deposition of the compounds specified in them. EMEP is developing models to be able to support the work under the two new protocols. As indicated above, a prerequisite for successfully modelling long-range transport is data on emissions and their geographical distribution.

10. EMEP will, by 2000, evaluate the basic long-range transboundary problems of small particles and, as needed, develop its monitoring and modelling activities in this field to be able to respond to the issues raised under the Convention.

11. The EMEP programme is implemented by Parties together with the Chemical Coordinating Centre (CCC) and the Meteorological Synthesizing Centres (MSC-E and MSC-W) in cooperation with the World Meteorological Organization (WMO). In practice, this means national monitoring work,

preparation of the national emission inventories, and financial support to the three EMEP centres through the UN/ECE Trust Fund for the Convention (or in kind) has to be detailed in the context of the annual work-plans and budgets. Flexibility between the EMEP centres is needed so that changing priorities and goals of work can be reflected in the budgeting of the available resources. Furthermore, EMEP needs to take into account the need to find external financing, possibly through the Trust Fund, for integrated assessment modelling under the Convention. EMEP already contributes scientifically to this work through its modelling input. However, there is a need to direct financial support to the modelling work of the International Institute for Applied Systems Analysis (IIASA) done for the Convention. The Executive Body will need to decide if the work of IIASA for the Convention should be financed through the EMEP budget, and how this work would best be accommodated in the existing EMEP structure.

12. The Steering Body of EMEP will continue to be responsible for all matters related to the effective implementation of the EMEP programme and it will report annually to the Executive Body for the Convention. All EMEP results will be made available through the Internet as soon as possible.

## II. DRAFT PROGRAMME FOR THE SEVENTH PHASE OF EMEP (1999-2001)

### Introduction

13. In its previous phases, including the sixth phase from 1995 to 1998, EMEP was structured to have a "chemical part", a "meteorological part", "emission data" and "other activities", which handled briefly cooperation with other relevant international programmes. Accordingly, the annual work-plan for the implementation of the Convention had a chapter on EMEP work with four sub chapters. The sub-chapters described in detail the chemical work done at the Chemical Coordinating Centre (CCC), the meteorological work (modelling) done at the two Meteorological Synthesizing Centres (MSC-E and MSC-W) and the work on emission inventories which is done at MSC-W, on a national level and by the Task Force on Emission Inventories. During the sixth phase, the last sub-chapter of the annual work-plan on "Cooperation between EMEP and other monitoring and modelling projects" was developed to better specify, *inter alia*, the increasing cooperation between EMEP and HELCOM and OSPARCOM. Starting with the 1998 work-plan, the division of work between the meteorological centres was fully implemented and specified in the work-plan.

14. However, in the future, the work of EMEP will be directed towards subject analyses and reports. The programme will provide information and analyses based on, inter alia: (i) emission data submitted by Parties in accordance with reporting obligations and guidelines or done as expert estimates in the cases where no data have been officially submitted; (ii) data from the EMEP measurement network, and other measured data giving complementary information of known quality; (iii) appropriate models describing atmospheric transport, chemistry and deposition; and (iv) appropriate data analysis methods.

15. Starting from the first year of the seventh phase (1999), EMEP would provide European-wide information and analyses in the following subject areas:

(i) Acid deposition;
(ii) Photo-oxidants;
(iii) Heavy metals;
(iv) Persistent organic and pollutants; and
(v) EMEP may provide information on small particles.

16. This kind of problem-oriented approach might be a feasible new structure for the overall work-plan for the implementation of the Convention. In that case, EMEP input should be mentioned under each of the topics as a sub-activity, as also effect-related work for instance. This structure would make it easier to create closer links between the work of the Convention's subsidiary bodies. Specific problems that the work of EMEP could address would include assessments of the success of the Convention and its protocols through analyses of emission, concentration and deposition trends of acidifying pollutants and photochemical oxidants, and assessments of the evolving patterns of exceedances of critical loads and critical levels. EMEP would also work in close collaboration with the Implementation Committee to monitor the Parties' implementation of the protocols.

17. For each subject area, the EMEP centres, taking into account their present division of work (to be specified in the context of the annual work-plan and budget), would cooperate in combining all relevant available information. They would cooperate in providing and analysing information on emissions, from monitoring network(s) and from atmospheric modelling of chemistry, transport and deposition, as well as in using appropriate data analysis methods. Furthermore, they would cooperate closely with national experts and take into account the work of other

national and international research groups. Chemical transport models would be proved, evaluated (including extensive comparison with measurements) and run operationally to provide a further basis for the analyses. Gradually, during the latter half of the seventh phase, photo-oxidants and acid deposition should be handled by one model.

18. A prerequisite for successfully carrying out the above analyses is that the quality and completeness of the basic information should be evaluated and properly reported. This should include reports on:

- Exact data submitted by Parties;
- Discrepancies in relation to approved reporting obligations and guidelines (such as the Atmospheric Emission Inventory Guidebook, guidelines on emission reporting (draft in EB.AIR/GE.1/1997/5), instructions on reporting monitoring data, monitoring data quality objectives etc.);
- Description of data quality and completeness.

Any need to change the agreed reporting procedures will always first be considered at the relevant international expert body (Task Force on Emission Inventories, workshops on monitoring, etc.) and approved by the Steering Body. In the EMEP measurement programme, the implementation of the quality assurance system and its supervision will be under the authority and responsibility of the quality assurance managers nominated at the national level.

19. The information and analyses described above should always meet the requirements of the Convention and its protocols and serve the needs of the Parties, the Executive Body and its subsidiary bodies. The annual work-plan should specify in more detail concrete requirements within each subject area.

## A. Acid deposition

20. The problems of acidification, eutrophication and photochemical oxidants have been addressed by the two sulphur protocols, the VOC Protocol and the NOx Protocol and its revision, which is currently under way. During the seventh phase of EMEP, therefore, the priority will be to monitor progress towards the targets embodied in these protocols and to assess, where practicable, the environmental improvements which have resulted, in terms of exceedances of critical loads and levels.

21. EMEP modelling of acidifying pollutants is done at MSC-W, which also develops, maintains and updates the emission database of the

relevant pollutants and verifies the quality of data in cooperation with other relevant bodies. CCC collects the monitoring data of these compounds. MSC-W and CCC will report annually on the long-range transport of the acidifying pollutants. An important part of the work is the estimates of the contributions of any country's emissions to acid deposition throughout Europe. On request, EMEP will also supply specific information for the joint implementation of the 1994 Sulphur Protocol.

22. MSC-W has supported the development of a new cost-efficient multi-pollutant multi-effect emission control protocol for nitrogen and sulphur compounds and other pollutants producing photochemical oxidants or contributing to acid deposition and will continue to do so. Models have been developed systematically to improve this support. The new 20-level Eulerian acid deposition model with a 50-km horizontal resolution encompassing the whole troposphere is being carefully verified. The use of this improved model in calculating country-to-country budgets will be an important task of the seventh phase.

23. Measurements in the acidification network could be relaxed to a weekly time resolution, making savings to accommodate increasing pressures in other areas. Nonetheless, it will be important to maintain quality through the implementation of the existing quality systems and National Quality Assurance Managers. It will also be important to extend the degree of standardization both within and between countries.

24. Increased interaction with participating countries and national experts will be important, and to assist in this EMEP data will be made easily available on the Internet, together with software for statistical analyses and modelling.

### B. Photo-oxidants

25. Ozone is being considered in the multi-pollutant, multi-effect protocol which is currently being negotiated. EMEP will continue to support this process with information and expertise. In the longer term, the emphasis will shift towards evaluating trends in ozone concentrations and assessing the success of the protocols, to the extent possible.

26. The development and verification of the Eulerian photo-oxidant model will also be an important part of the seventh phase. The extension to incorporate acidifying and eutrophying pollutants and improvements in the gas and aqueous phase chemistry will make significant progress

towards achieving a combined oxidant/acidification model. In this context, the work with global models will also be important, not only in assessing the future trends of tropospheric baseline concentrations of ozone, but also the influence of source regions outside Europe on European ozone levels and exceedances of critical levels.

27. To assess ozone levels and to verify the models, it is important to have as comprehensive and up-to-date measurement data as possible. Efforts will be made to improve the reporting of ozone data from participating countries, and to extend, whenever practicable, the measurements of ozone and its precursors.

### C. Heavy metals

28. The development of modelling of heavy metals will have to proceed hand in hand with the work on effects and critical loads. If that work concludes that an effect-based second-stage protocol is scientifically viable, and if this is endorsed by the Executive Body, then, work could in principle, proceed further in EMEP to model the transboundary transport of the appropriate metals. Equally, however, before these conclusions could be reached, the modelling basis (including emission inventories and measurement base) would have to be robust. Current models are under development, and it will be essential that these models are carefully assessed. This should take place in 1999.

29. EMEP modelling of heavy metals is done at MSC-E, which receives officially reported emission data from the database at MSC-W. MSC-E participates, in cooperation with CCC and other experts, in producing and evaluating other emission data (expert estimates) needed for the model development if no official emission data are submitted. The main goal of this activity is to provide the Executive Body with calculations of transboundary fluxes and depositions of heavy metals within the geographical scope of EMEP. The first priority will be given to further developing lead, cadmium and mercury transport models. In the previous phase, tentative calculations of transport, depositions and concentrations of these metals were started. The model of lead was part of the model intercomparison study and demonstrated reasonable results. Beginning with 1999 the main attention will be given to investigations of particle-size distribution and to the improvement of parametrization of dry and wet deposition processes for lead and cadmium models. In regard to mercury, it is planned to improve the physical-chemical scheme of Hg transformations in the atmosphere, to develop the surface-atmosphere exchange module and to undertake an intercomparison study. While fulfilling this work, MSC-E will cooperate with HELCOM, WMO, EUROTRAC

(MEPOP), GKSS (Germany), IVL (Sweden) and the Advisory Group. During the seventh phase of EMEP, three-dimensional Eulerian models for lead and cadmium transport will be developed and used on an operational basis. Provisions of information on depositions and concentrations with spatial resolution 50x50 $km^2$ and country-by-country matrices, trend analysis and exceedances of critical loads (if available) is planned.

30. It is proposed that trace metals, first priority Hg, Cd, Pb, and second priority Cu, Zn, As, Cr, Ni, should be included in the EMEP measurement programme. Taking into account the recommendations from previous workshops on HMs, and in particular the Moscow workshop in 1996 (WMO GAW Report No. 117, EMEP/MSC-E Report 1/97), about ten sites would be sufficient for modelling purposes in Europe: in northern and southern Scandinavia, western Russia/Belarus, southern Finland/Baltic, Baltic/Poland, central Europe/Czech Republic/Slovakia/Hungary, Balkan, Ireland/United Kingdom, Portugal/Spain, southern France/Italy, and Germany/Netherlands. Air sampling should be carried out with a high-volume sampling with two size fractions (cut-off at 2.5 and 10 um). One 24 h air sample every week would be sufficient. Sampling of gaseous Hg should be by gold traps. Precipitation sampling should be weekly bulk with two samplers in parallel. Additionally, more intensive measurement campaigns could be foreseen. A first step in the HM activity may be to organize a technical expert meeting to share experience and discuss sampling and analytical procedures. There is a need to organize laboratory comparisons of HMs. CCC should include standard operating procedures and quality control routines in the manual for sampling and chemical analysis (EMEP/CCC-Report 1/95).

31. Large-scale moss surveys have been carried out regularly in the Nordic countries, in order to give information about the spatial and temporal trends of the HM deposition. In 1995 more than 30 countries in Europe took part in this work. EMEP should make use of the moss data, and consider entrusting CCC with coordinating the future activity in this field. CCC also collects the HM data available from other international programmes.

### D. Persistent organic pollutants

32. The remarks on heavy metals in paragraph 28 above also apply to POPs. The development of an effects-based approach is perhaps more difficult than for heavy metals, and the needs of the Executive Body in terms of information from EMEP will need to be clarified as the Protocol on POPs proceeds towards ratification and implementation. The models

currently being developed should also be assessed in 1999.

33. EMEP modelling of persistent organic pollutants is done at MSC-E, which receives officially reported emission data from the database at MSC-W. MSC-E participates in cooperation with CCC and other experts in producing further emission data needed for the model development.

34. CCC collects the monitoring data of POPs available from other international programmes. A large number of POPs may be considered for inclusion in a measurement programme. Due to the time-consuming and expensive chemical analysis, and the low concentrations of some POPs, both the sampling techniques and the analysis must be taken into account when selecting compounds. It is proposed (WMO GAW Report No. 117, EMEP/MSC-E Report 1/97) that PAH, PCB, HCB, chlordane, lindane, a-HCH, DDT/DDE should be included in the EMEP measurement programme in a stepwise approach, starting with high-volume sampling in air at a small number of sites. The air sampling period should be 24 or 48 hours, and the sampling frequency once every week. The same type of high-volume sampler should be used at all sites. In a first step five sampling sites should be sufficient; Scandinavia/Baltic, northern Atlantic region, continental Europe, Mediterranean region, south Atlantic region. To accomplish this, it may be considered to give financial support to laboratories which would be able and willing to analyse samples from one or more countries, or if feasible, to find one central laboratory. The first step in the programme should be a laboratory comparison. CCC should include standard operating procedures and quality control routines in the manual for sampling and chemical analysis (EMEP/CCC-Report 1/95).

35. POPs show a wide range of physico-chemical properties and, therefore, no general conclusions on their environmental fate can be drawn. For this reason, investigation of the main physico-chemical properties of the selected POPs in different environmental compartments needs to be continued. The relative importance of various processes, such as gas/aerosol partitioning, dry deposition and revolatilization, wet deposition and degradation in various compartments, strongly depend on compound-specific properties like vapour pressure, solubility, etc. and on properties of the medium, e.g. of its organic matter content. Even within a group of chemicals (PAH, PCB) the individual congeners may show different behaviour. The development of multi-compartment models combining a transport scheme with atmosphere/soil, atmosphere/water and atmosphere/vegetation modules would facilitate a comprehensive evaluation of POPs.

36. The atmospheric residence time of POPs range typically from days (particle- bound POPs) to several weeks (gaseous POPs) and up to years (very volatile and lypophilic POPs). Therefore, the transport of POPs needs to be considered not only on a regional but also on a global scale. POP models need to be able to estimate the transport in and out of the EMEP region and inside the region (e.g. the marine regions and the Arctic area need specific attention).

37. The quality of the input data of the POP models, in particular the emission data, will be further evaluated as the data become available. The physico-chemical properties and model parameters will also be carefully analysed.

### **E**. **Small particles**

38. In recent years, it has been recognized that the health effects of fine particles are more important than previously thought. Epidemiological studies, initially in the United States, but more recently also in Europe, have derived associations between $PM_{10}$ and $PM_{2.5}$ and mortality. Overall risk estimates have suggested that, of the pollutants covered by current legislation, those associated with particles tend to be among the highest. Moreover, a significant fraction of ambient concentrations of fine particles in Europe arises from the long-range transboundary transport of particles formed by atmospheric reactions chiefly involving sulphur and nitrogen oxides and ammonia. The Executive Body duly discussed the need for a protocol on particles and decided to establish a joint task force with the World Health Organization to investigate the scientific and health-related issues. The work of EMEP will provide this task force and the Executive Body with further information on the transboundary transport of particles.

39. Present EMEP models for the acidifying pollutants can be used to estimate the concentration of particles arising from gaseous emissions of $SO_2$, NOx and $NH_3$. These particles generally constitute a large part of the small aerosol ($PM_{2.5}$) but a smaller part of the large aerosol ($PM_{10}$). The present models for acidifying pollutants could, therefore, be used with some adjustment to estimate the regional concentrations of the small particles but not of the large ones. Developing models for the long-range transport of the large aerosol would be a major effort. It would be necessary, inter alia, to establish a finer geographical resolution than 50 km.

40. Much of the needed research for sulphur, ozone and fine particulate matter overlaps. Atmospheric oxidation reactions are important also in particle formation, besides ozone. Modelling the transport and fate of sulphur, ozone and particles relies on similar meteorological processes, the same computational framework, similar emission inventories and model initializations. However, there are a number of necessary steps required for performing a realistic modelling of particulate matter. This involves considerations of emission inventories for primary particles, the atmospheric chemistry of secondary particle formation including fog and cloud processes, the incorporation of aerosol dynamics and deposition, and the characterization of background aerosols. As a first step, the existing EMEP models could be modified as follows:

(a) The sulphate and nitrate concentrations are already determined by the acid deposition models. These contribute to the aerosol mass in the size range below 2.5 Fm;

(b) The Langrangian model, or one of the models which are being used to model HM transport, may both be easily modified to describe the concentration of primary aerosol particle components, provided that adequate emission data can be made available;

(c) Secondary organic aerosol concentrations will be estimated by the EMEP photo-oxidant model, adding a secondary organic aerosol formation module;

(d) Adding an aerosol dynamics module, which is necessary to determine the size distribution of the aerosol components, will require the combination of information from three models.

41. The measurement of particles is a complex task. As a first step, the following action could be taken:

(a) The existing EMEP monitoring sites should be used for $PM_{2.5}$ and $PM_{10}$ monitoring. This will achieve multiple monitoring objectives for a moderate increase in costs. The $PM_{2.5}$ and $PM_{10}$ measurements will need to be carried out with at least daily time resolution, in order to determine actual exposure of human receptors;

(b) A network of core monitoring sites could be established for determining the chemical composition of the aerosols, and relate the aerosol mass to different types of primary aerosol emissions and

secondary aerosol formation under different conditions and in different parts of Europe. These core monitoring sites should also be able to carry out denuder measurements to separate nitrate in aerosols from $HNO_3$;

(c) The Working Group on Effects under the Convention has highlighted the need for measurements of the base cation content of aerosols, and for separation of the gaseous and particulate nitrogen species in air. These objectives should also be taken into account.