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(Item ... on the provisional agenda)

EMEP/WMO WORKSHOP ON FINE PARTICULATES
EMISSIONS, MEASUREMENTS AND MODELLING
Note prepared by the secretariat

Summary

The EMEP/WMO Workshop on Fine Particulates: Emissions, Measurements and Modelling took place from 22 to 25 November 1999. Fine particles were for the first time included in the 1998 work-plan for the implementation of the Convention, owing to the growing concern about their health effects. The aim of the Workshop was to carefully review emission inventories, modelling, and measurement of fine particles. The Workshop adopted a set of conclusions and recommendations for future EMEP/WMO activities in this field.

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Introduction

1. The EMEP/WMO Workshop on Fine Particulates: Emissions, Measurements and Modelling took place from 22 to 25 November 1999 in Interlaken (Switzerland). It was organized by the Swiss Agency for the Environment, Forests and Landscape and the Swiss Federal Laboratories for Materials Testing and Research, in cooperation with the Chemical Coordinating Centre (CCC), the Meteorological Synthesizing Centre West (MSC-W) and the World Meteorological Organization (WMO).
2. Sixty-nine experts from 16 countries: Austria, Belgium, Canada, Croatia, Czech Republic, Estonia, Finland, France, Germany, Italy, Lithuania, Netherlands, Spain, Sweden, Switzerland and United Kingdom; and from the following organizations: CCC, Meteorological Synthesizing Centre East (MSC-E), MSC-W, World Health Organization (WHO), WMO, European Commission, the Joint Research Centre of the European Commission in Ispra and the UN/ECE secretariat, attended.
3. Fine particles were for the first time included in the 1998 work-plan for the implementation of the Convention on Long-range Transboundary Air Pollution, owing to the growing concern about their health effects. The aim of the Workshop was to carefully review emission inventories, modelling, and measurement of fine particles. A major objective of the Workshop was to provide recommendations for future EMEP/WMO activities on this issue. The Workshop included invited introductory plenary presentations of the main topics dealt with and poster presentations.
4. In his opening statement, Mr. U. Nyffeler (Switzerland) stressed that many studies, conducted in various parts of the world as well as in Switzerland, had in the past decade shown a clear link between a wide range of health effects and exposure to particulate matter in ambient air. The small size fraction of the ambient aerosol, measured as PM_{10} and $PM_{2.5}$, were considered to be responsible for most of the health effects. Recent studies had revealed that for instance, in Switzerland - with a population of 7 million - 3 300 deaths might be related to exposure to PM_{10} . The costs of the mortality together with the morbidity costs were estimated at over 4 billion euros per year. It was therefore important to increase the awareness of the problem of air pollution by particles and the willingness to implement adequate solutions.
5. Mr. M. Krzyzanowski of the WHO European Centre for Environment and Health introduced the preliminary assessment of health risk of particulate matter from long-range transboundary air pollution published jointly by WHO and ECE in 1999. Particulates from long-range transport were thought to be responsible for more than 100 000 deaths per year in Europe. However, those estimates were very uncertain. To improve their reliability, intensive

toxicological and epidemiological research was needed to better identify the hazardous characteristics of the particulates. Improving exposure estimates required better pollution dispersion models and reliable, up-to-date emission inventories, supported by monitoring and assessment programmes.

6. Ms. E. Lumme of the ECE secretariat informed the participants about the current major activities under the Convention, the consideration of fine particulates by the EMEP Steering Body and the decisions of the Executive Body to include the particulate matter in its latest work-plans. Ms. L. Tarrason of MSC-W considered the scientific status of and the need for modelling the long-range transport of particulates. Mr. M. Woodfield, Chairman of the Task Force on Emission Inventories, reported on the status of the emission inventories and the problems faced in this work. Mr. J. Berdowski (Netherlands) described more in detail the 1990 emission inventory done by the Netherlands experts for the whole of Europe. Furthermore, Mr. Gehrig (Switzerland) reviewed the current measurement techniques, and Mr. J. Heintzenberg (Germany) described the more advanced measurement techniques for fine particulates.

7. Ms. L. Edwards of the European Commission reported on the activities of the Environment Directorate's Air Quality Unit. The European Commission needed to report on the implementation of the first daughter directive under the Air Quality Framework Directive by the end of 2003. The report would also cover particulate matter, including possible proposals for new limit values for fine particles. In its preparatory work, the European Commission had noticed, inter alia, the need for up-to-date information on particle emissions.

8. Particulate matter was also studied under other international programmes. Mr. U. Baltensperger of WMO informed the Workshop about the aerosol measurements within the WMO Global Atmospheric Watch (GAW) Programme, which aimed to determine the spatio-temporal distribution of aerosol properties related to climate change. Mr. T. Brink (Netherlands) reported on the aerosol formation studies under the Eureka Project on the Transport and Chemical Transformation of Environmentally Relevant Trace Constituents in the Troposphere over Europe (the second phase of EUROTRAC). During the Workshop national and international research projects were also presented with the help of more than 30 posters.

9. Ample time was devoted to expert discussions both in the plenary and in the three sessional working groups. Mr. M. Woodfield chaired the working group on emissions, Mr. A. Semb of CCC the working group on measurements and Ms. L. Tarrason the working group on modelling. The conclusions and recommendations as adopted at the end of the Workshop and finalized thereafter by the secretariat in consultation with the chairpersons of the working groups and the Swiss hosts are detailed below.

CONCLUSIONS AND RECOMMENDATIONS

A. Working group on emissions

10. The sessional working group on emissions was attended by about 17 participants, both users and providers of inventories, representing modelling, regulatory, government and industry interests. The working group explored and prioritized the issues associated with establishing fine particulate inventories before 2003. The following items were identified as needing special attention:

- The physical and chemical characteristics of particles;
- Source apportionment;
- Data quality and confidence;
- Speed of delivery.

11. To meet any future reporting requirements under the Convention and provide input for the CORINAIR/EMEP Atmospheric Emission Inventory Guidebook, Parties should prepare an interim emission inventory by the end of 2000. A formal system would be required by 2001 for reporting fine particle emissions. 1995 would be a suitable base year from a technical point of view.

12. The inventory of the Netherlands Organization for Applied Scientific Research (TNO) for 1990 could be used as a basis for the interim emission inventory. It should be revised and updated during 2000. The Executive Body should include this activity in its 2000 work-plan.^{1/} The revision should be undertaken by a contractor and funding should be earmarked for this purpose. The work should be supervised by the Parties to the Convention. This inventory would be supplemented by national information where available.

13. From 2001 onwards the Executive Body should include the establishment of a fine particulate emission inventory in its annual work-plan. This would require much input from the Task Force on Emission Inventories and Projections. PM₁₀ and PM_{2.5}, heavy metal, elemental/organic carbon and mineral dust data should be reported at a minimum at SNAP level 2. Also, the reporting instructions should be revised to reflect this. In addition, the SNAP coding and any related statistics should be extended and the Guidebook revised accordingly.

^{1/} At its seventeenth session (29 November-3 December 1999), the Executive Body took the action proposed in paragraphs 11 and 12 into account when finalizing its work-plan for 2000. In this context, it also agreed that a decision on including a fine particulate emission inventory in the annual work-plans from 2001 onwards would be taken at its eighteenth session in 2000, following the final advice of the EMEP Steering Body.

14. The experience of the European Environment Agency was highly relevant to the establishment of high-quality fine particulate inventories. The European Community expressed its strong interest in this work and it was agreed that it, possibly through the European Environment Agency, should be invited to continue with its valuable contribution to the EMEP programme.

15. Inventory quality management should be introduced as a prerequisite for data validation and inventory verification. Guidance on the quality management of the inventories should be included in the Guidebook.

16. The working group recognized the value and relevance of the work on fine particulate emissions by a number of other organizations. Wherever possible EMEP should cooperate with these groups to avoid duplication and to promote harmonization. In particular, contact should be maintained with the fine particulate programme of the United States Environmental Protection Agency (US/EPA) and the inventory best practice programme of the Intergovernmental Panel on Climate Change (IPCC).

17. Assistance should be provided to characterize temporal variations of emissions through a formal liaison with EUROTRAC via its GENEMIS programme.

B. Working group on measurements

18. The sessional working group on measurements was attended by about 30 participants, mainly measurement experts involved in EMEP and in other national and international research programmes. They explored the possibilities for introducing measurements of fine particulates into the future EMEP measurement programme, bearing in mind:

- The needs of the data users, in particular the modellers;
- The current state of measurement techniques for sampling and analysis;
- The limited resources at most EMEP sites;
- The possible synergistic effects of cooperation with other scientific programmes.

19. EMEP should give first priority to PM₁₀ measurements. For this purpose the gravimetric method (currently official PM₁₀ reference method) was preferred, particularly because the filters allowed subsequent chemical analysis for quantification of different compounds. Monitors were acceptable if they had been shown to deliver equivalent results for the specific site and for all seasons.

20. EMEP sites should also determine secondary inorganic particulate matter, i.e. ammonium sulphate and ammonium nitrate, as well as other water-soluble ions when these made up a significant part of PM₁₀ mass.

21. Measurements of particles with an aerodynamic diameter of less than 2.5 or 1 μm should be carried out in the near future when the definition of the European reference method was in place.

22. For chemical characterization, the determination of elemental and organic carbon was highly desirable. The subsequent determination of organic and elemental carbon by thermodesorption and oxidation was subject to artefacts, and care had to be taken to avoid results that were not comparable. There were also sampling artefacts related to organic compounds. EMEP would need to consult other bodies on these issues. If they could be resolved, centralized laboratories for the determination of elemental and organic carbon should be established for the analysis of samples from EMEP sites.

23. More detailed size fractionated chemical speciation would be desirable and should be done in the context of scientific projects.

24. “Superstations” should be set up together with other scientific organizations and programmes. These could be used for a number of chemical and physical measurements that go beyond the scope of the “normal” EMEP site, e.g. for the determination of some of the organic compounds, size distribution, detailed size fractionated chemical speciation, optical properties, water uptake, cloud condensation nuclei, vertical distribution and better time resolution (1 hour) for certain parameters.

25. The participants representing EMEP welcomed closer collaboration with other international initiatives, such as GAW of WMO and EUROTRAC, as well as national programmes. This collaboration would concern both measurements and modelling, in particular the EUROTRAC subproject AEROSOL. It would accelerate the exchange of scientific and technical information and improve understanding between EUROTRAC and EMEP.

26. EMEP and WMO representatives saw a large potential for collaboration in the fine particulate programme. Many measurement sites in Europe were already both EMEP and GAW sites. This could still be extended. In particular, global GAW stations could possibly be designated as “superstations” within EMEP (see para. 24 above). The newly formed Task Force on Measurements and Modelling, co-chaired by Austria and WMO, was expected to be best suited to address this task. These joint activities at common sites would help to produce more comprehensive results.

27. The EMEP/CCC website (<http://www.emep.int>) should be used to share information on ongoing and planned research and compare measurement techniques.

C. Working group on modelling

28. The sessional working group on modelling was attended by about 15 participants, mainly modelling experts involved in EMEP and in other national and international research programmes. The working group discussed the main objectives of modelling particulate matter and set requirements for:

- The development of chemical and physical model parametrization;
- The necessary input emission data;
- The necessary measurement data for model validation and model development.

29. The working group appreciated the MSC-W proposal to couple the Eulerian photo-oxidant model with an aerosol model and encouraged the ongoing collaboration between MSC-W, CCC, the University of Helsinki, the University of Stockholm and the Finnish Meteorological Institute, in the framework of the Nordic Research Council (NMR). This modelling effort was likely to produce preliminary initial results on the long-range transport of particulate matter in the EMEP area by the beginning of 2001.

30. The working group requested MSC-W to investigate cloud effects, gas-aerosol interaction through evaporation and condensation processes, sea-salt chemistry and resuspension processes, already at the initial model development stages.

31. The participants welcomed cooperation with national and international research programmes. In particular, areas for cooperation were identified, both in terms of process studies and suggestions for parametrization schemes, model intercomparisons and testing of different model approaches with national experts from the United Kingdom and the research group at the Ford Research Center in Aachen (Germany).

32. As a first priority, the particulate matter model used by EMEP should provide daily values of PM_{10} and PM_x and be able to characterize the chemical speciation of the aerosol. Concerning the size distribution of the aerosol, the model approach should be flexible enough to allow for any changes in the ranges defined by legislation. Monitoring sites should include daily measurements of PM_{10} and $PM_{2.5}$ and chemical characterization of secondary inorganic aerosols and other water-soluble ions.

33. Chemical speciation of particulate matter was important for source allocation and it was recommended that secondary inorganic particulate matter should be separated from the other components of particulate mass. The quantification of elemental carbon and organic carbon was also desirable, as these represented the major part of the primary emissions of particulate matter.

In view of the technical difficulties in the separate determination of elemental carbon and organic carbon, centralized laboratory facilities should be established to ensure compatible data.

34. A minimum of 5 to 10 sites should be selected to carry out detailed chemical speciation and chemical mass balance of measured PM_{10} and eventually also $PM_{2.5}$ or PM_1 . These sites should be part of the basic EMEP measurement network, or other related monitoring activities, and should cover the following areas: southern Europe (Saharian dust, biomass burning), eastern Europe (biomass burning), central Europe (anthropogenic), marine and remote areas. CCC, in cooperation with WMO, should select them.

35. In addition, campaign sites and “superstations” (see para. 24 above) related to the specific research programmes would be specially useful for the testing of the model parametrization.

36. The working group also considered the requirements for emissions inventories, which were further considered by the working group on emissions. Natural and biogenic emissions and resuspended material should be directly treated by models in collaboration with emission experts.

37. Work should be initiated within the Task Force on Integrated Assessment Modelling to investigate, in collaboration with the Working Group on Effects and WHO, the robustness of different statistics that could be used in atmospheric modelling as indicators of the effect of particulate matter on human health.