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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-sixth session, Geneva, 2-4 September 2002)
Item 5 (g) of the provisional agenda

MEASUREMENTS AND MODELLING

Progress report prepared by the Chairpersons of the
Task Force on Measurements and Modelling in collaboration with the secretariat

Introduction

1. This report presents progress on atmospheric measurements and modelling, including the results of the third meeting of the Task Force on Measurements and Modelling, held at the World Meteorological Organization (WMO) in Geneva on 19-22 March 2002. The meeting included a joint session of the seventh Workshop on Air Quality Management and Assessment of the European Environment Information and Observation Network (EIONET) addressing the harmonization of data reporting, and questions related to particulate matter and ozone pollution.

2. This report presents proposals for further work to revise the EMEP monitoring strategy and for the particulate matter monitoring manual. It also reports on progress in the preparation of the assessment report on the changes in transboundary fluxes, depositions and concentrations. Furthermore, the Task Force reviewed the status of work on persistent organic pollutants (POPs) and further discussed the differences between the Lagrangian and the Eulerian models.

3. The presentations made at the third meeting of the Task Force are available on the Internet at www.ubavie.gv.at/tfmm.

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4. Experts from the following Parties to the Convention participated: Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, the former Yugoslav Republic of Macedonia, the United Kingdom, the United States and the European Community. Experts from Albania and Japan were also present. Furthermore, representatives from the four EMEP Centres, the Centre for Integrated Assessment Modelling (CIAM), the Chemical Coordinating Centre (CCC), the Meteorological Synthesizing Centre East (MSC-E), and the Meteorological Synthesizing Centre West (MSC-W), the European Environment Agency (EEA), the European Community’s Joint Research Centre (JRC), WMO, and the Oil Companies’ European Organizations for Environment, Health and Safety (CONCAWE), as well as the UNECE secretariat, attended.

5. Ms. Liisa JALKANEN (WMO) and Mr. Jürgen SCHNEIDER (Austria) co-chaired the meeting.

6. In his welcoming address, the Deputy Secretary-General of WMO expressed his satisfaction with the close cooperation between the WMO Global Atmosphere Watch (GAW) programme and EMEP. He also emphasized the importance that WMO attached to the issue of particulate matter pollution and to the close international cooperation on POPs, as recently confirmed in a decision by its Congress. The Task Force and EIONET thanked WMO for the warm welcome and hospitality that they had received on its new premises.

7. The UNECE secretariat informed the Task Force about the recent developments in the framework of the Convention, highlighting the timing adopted by the Executive Body for the reviews of the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone and the Protocols on POPs and Heavy Metals. It also drew attention to the decisions relevant to the Task Force’s work, in particular the adoption of the terms of reference and the work programme.

8. The representative of the European Commission informed the joint Meeting about progress in the work under the Clean Air for Europe (CAFE) Programme, highlighting the timetable and the elements of the thematic strategy to be developed on the basis of the CAFE work. She emphasized that CAFE relied on many of the data to be developed under the Convention and within the framework of EIONET.

I. ASSESSMENT OF CHANGES IN TRANSBOUNDARY FLUXES; DEPOSITIONS AND CONCENTRATIONS

A. Planning of the preparation of the assessment report

9. The Task Force on Measurements and Modelling discussed progress in the preparation of the assessment report. The report aimed at providing a basis for the next round of negotiations and serving national needs. It would be a joint report prepared by national experts associated with the work of EMEP and the EMEP centres. Part 1 was to cover the overall European perspective, while part 2 would focus on developments in individual countries.

10. Mr. Anton Eliassen of MSC-W presented the structure adopted by the EMEP Bureau at its meeting from 28 February to 1 March 2002. The Bureau had discussed the work on the assessment report as a priority. It had noted that several Parties had started work with the support of CCC and MSC-W, but that progress had not been sufficient and in some cases incoherent. It had recognized that the objectives of this work were set out in the report of the EMEP Steering Body (EB.AIR/GE.1/2001/2, para. 61):

> The report intended to provide an assessment of twenty years of experience and evaluate the data on transboundary air pollution to determine the needs for further policy measures, in particular with a view to the reviews of the protocols. In the country-specific part, Parties should assess: (i) the results of emission reduction measures within the country and internationally; (ii) the present status in relation to the desired environmental quality; and (iii) the need for further action to reduce pollution levels.

11. The Bureau had welcomed and accepted the offer by Mr. Anton Eliassen (MSC-W) to support the work on the assessment report. It had adopted the following structure for the continuation of the work:

(a) The assessment report leader (Mr. Anton Eliassen), together with a support group consisting of Mr. Sergey Dutchak (MSC-E), Mr. ∅ystein Hov (CCC), and Bureau members Mr. Peringe Grennfelt and Ms. Sonja Vidic, would further define the objectives of the work, develop the questions to be addressed and elaborate the outline of the report. A coordinator would work full-time on the report at MSC-W to assist the work as a contribution in-kind from Norway. He would direct the work of the Parties and gain the necessary support so that all relevant regions (Balkan, Mediterranean, Iberian Peninsula, Central Europe, Eastern Europe, Nordic countries, North-Western Europe) would be covered. He would ensure responses by national experts, as needed by the centres. The work would cover information available on: observations (checked data quality); model calculations of concentrations and deposition; and flux calculation between countries (checked data quality). It would aim at evaluating trends in sulphur, nitrogen, ozone, heavy metals and POPs and discuss emission changes, including the influence of legislation, changes in climatology (meteorology, changes in surface characteristics) and data quality;

(b) An editorial committee, led by Ms. Gun Lövblad of the Swedish Environmental Research Institute (IVL) and including Mr. Sergey Dutchak (MSC-E), Ms. Leonor Tarrasón (MSC-W) and Mr. Kjetil Torseth (CCC), would be responsible for the general part of the report, giving an overall European perspective with the following chapters: (1) acidification and eutrophication, (2) ozone, (3) heavy metals and POPs, (4) summary. In writing these chapters, the committee would cooperate with the contributing authors that had already offered to participate or would do so in the future.

12. Mr. Eliassen pointed out that work using the new structure had started and the coordinator (Mr. J. Bartinicki) had been appointed. The coordinator would soon contact national experts and assist them in clarifying the tasks that were expected of them.

13. Ms. Gun Lövblad (IVL) presented an overview of the work that had been carried out. Experts from 19 Parties had checked or started to check the measurement data that CCC had made available on the Internet. Twenty-two Parties (Austria, Belgium, Denmark, Estonia, Finland, Croatia, Czech Republic, Germany, France, Hungary, Latvia, Lithuania, Ireland, Italy, Netherlands, Norway, Slovakia, Slovenia, Sweden, Switzerland, the former Yugoslav Republic of Macedonia and Yugoslavia) had announced interest in participating or had already started the assessment work. Seven of these were cooperating within the framework of the Nordic/Baltic project.

14. The following timing should be followed:

- Outline of national contributions, by early April;
- Data checked before 31 May;
- By 15 August 2002, a first draft of the national assessments prepared. Progress to be reported to the EMEP Steering Body;
- Autumn 2002, workshop under the auspices of the Task Force to present the results of national assessments and discuss conclusions for the general part;
- National assessments completed by the end of 2002;
- Work on the European assessment completed by March 2003;
- Editing of the report in the first half of 2003. Report printed in June 2003 and presented to the EMEP Steering Body in September 2003.

A new web site dedicated to the work on the assessment report would be added to the EMEP homepage (www.emep.int) to provide an updated overview of the status of work and allow easy access to all the data and tools.

15. Mr. Kjetil Torseth of CCC presented the work done on quality assurance and data quality. While EMEP had been collecting data since 1978, the first field intercomparison was conducted only in 1986. CCC had so far prepared some 150 reports, many providing important information related to the quality of data. One of the main problems with the data time series was the differences in methodologies used. CCC had presented a new flagging system to the Task Force at its second meeting. It would now add the flags to the data in consultation with national experts. Many countries had reviewed their measurement data, and had found most discrepancies between national data and the data at CCC, but the differences were usually small. The reasons for the deviations included: errors in transferring data to the Web; use of conversion factors; corrected or rejected data; and errors in files submitted or punching errors. Very few experts had, however, really reassessed the data taking into account possible systematic changes, e.g. connected with changes in methods. National documentation on reporting and corrections was also in some cases scant. CCC invited experts to continue the checking data and present any corrections. It would update the data on the Internet, once most corrections had been made.

16. Mr. Sergey Dutchak of MSC-E presented an overview of the data that MSC-E had posted on the Internet for the assessment of POPs and heavy metals. For heavy metals (cadmium, lead and mercury), emissions, measurements, pollution trends, and transboundary transport data were available for the period from 1990 to 2000. Data on critical load exceedances for cadmium and lead would be presented if they became available on time. POPs data covered the pollutants included in annex III to the Protocol on POPs. Emission data were presented from 1970 to 2000. An analysis of available measurements in environmental compartments and contamination trends was given. For PAHs, transboundary transport data were presented. The data were organized by country and nationally reported data were supplemented by expert estimates, where necessary. National experts were invited to use the data and to provide any comments they had to MSC-E.

17. Ms. Anna Benedictow of MSC-W presented the two-dimensional trajectory model results which it had made available for all EMEP stations on the Internet. She also informed the Task Force of the Internet-accessible emissions database that would be available on the Internet in June 2002. Moreover, MSC-W would continue working on the development of an Internet-accessible version of the Lagrangian model, which was expected to be available in 2003 or 2004. The Task Force welcomed the work done. Many experts stressed the usefulness of the data and some suggested additional data that could be of use for their work. MSC-W promised to study the additional suggestions and implement those that it could cover with the limited resources available for this work.

18. Mr. T. Salmi (Finland) presented an Excel template developed within the framework of a research project funded by the Nordic Council of Ministers. The template allowed the estimation of annual trend statistics, based on the Mann-Kendall test and the non-parametric Sen`s method. The

application of the template to Finnish data on gaseous pollutants and precipitation was demonstrated. The Task Force appreciated the offer to make the template and a manual describing its features available to the national experts working on the assessment report.

19. The Working Group on Effects was also working on a similar report, a substantive report to be prepared by 2004. The report should give an integrated perspective of the state of the environment and an impact assessment, including health risks, to highlight the results of the implementation of the protocols to the Convention. It should also highlight any need for further abatement measures and assess requirements for further work on the environmental effects of air pollution. An outline of the report had been prepared by the Bureau of the Working Group on Effects and was being annotated by the International Cooperative Programmes (ICPs) for presentation to the Working Group on Effects in the summer. The work on atmospheric trends in this substantive report should be harmonized with the work under the assessment report. The EMEP Bureau had invited the Chairman of the Working Group on Effects to collaborate in the work on the assessment report to ensure consistency in the results.

20. The Task Force welcomed the initiative of the EMEP Bureau and the new organization of work for the assessment report. It expressed its appreciation to the centres for their work. It emphasized the need for close collaboration between the centres and the national experts. It welcomed the idea of presenting the work on the assessment report on a special web site emphasizing, however, that it was not sufficient to post data on the Internet, it was also necessary to contact experts directly. The Task Force recognized the importance of good cooperation with those working on the substantive report of the Working Group on Effects. It noted the absence in the current outline of the EMEP assessment report of a special chapter on particulate matter. This should be explained to avoid any misunderstanding when the report was being used for policy purposes.

21. Ms. Sonja Vidic (Croatia) presented an assessment of the Lagrangian model performance with long-term data from a station in Croatia. Comprehensive work had been done to compare measured and modelled data on acidifying pollutants. For this exercise, measurement data from a Croatian EMEP site and results from the EMEP Lagrangian model available on the EMEP web site (modelled concentrations, sectoral data and trajectory data) had been used. The measured and modelled concentrations of several components showed reasonable agreement, while the model underestimated the amount of precipitation.

22. Mr. Ron Smith (United Kingdom) presented the preliminary results of an alternative analysis of trends in EMEP measured concentrations. The study was intended to develop a flexible non-parametric trend method suitable for an improved overall trend analysis of EMEP data for the United Kingdom. He explained that the EMEP data could be analysed by a range of statistical

techniques, from the relatively simple to the very complex. He encouraged experts to use whatever techniques they were familiar with. It was important: (i) to identify the purpose of the analysis, (ii) to use the appropriate data (e.g. annual statistics for comparison with annual emissions), and (iii) to be aware of the limitations of the statistical analysis.

B. Assessment of ozone trends

23. Mr. R. van Aalst (EEA) presented an evaluation of ozone data from the AIRBASE database highlighting the day-of-the-week dependence and trends in ozone mean values and in ozone exceedances. Trends in ozone means at urban background stations were more upward than at rural stations. Work done at the German Federal Environmental Agency on long-term ozone trends for Germany was also presented. A time series from 1980 to 1997 with data from all German stations showed the significance of the weekend effect.

24. Mr. M. Roemer (Netherlands) presented the results of studies examining ozone trends, including work conducted in the framework of the EUROTRAC2 project TOR2. His work shows that the data set of the monitoring networks need screening before it can be used for trend analysis, since the full data set contains artefacts, such as discontinuities, which in a few cases can be linked to changes in monitors, calibration, etc. Observations in polluted areas show a substantial decrease in non-methane volatile organic compound (NMVOC) and CO (-35/-50%), and NO_x (-20/-40%) levels over the past 10-15 years. Regression models that take into account meteorological factors have been used and they give more accurate and robust trend estimates. There is very strong evidence that ozone peak values have decreased over the past 10 years, and that this reduction is due to emission changes. However, dispersion models need to be validated on their trend performance before they can be used in a policy evaluation. Mr. Roemer's results confirm that there is very strong evidence that low ozone values (low percentiles, winter values) in polluted areas have increased. It is clear that the reduction of ozone titration (lower NO_x emissions) explains a large part (perhaps even all) of this increase. In Western Europe there are indications of an increase in ozone in the unpolluted (background) sectors. The causes of the increase are not clear yet.

25. Ms. L. Rouïl (France) presented a comparison of data modelled with the French large-scale Eulerian model, CHIMERE, with measurements of ozone concentrations from 220 European stations. This work has been done for the year 2001 using several kinds of criteria such as statistics on daily maxima, time series, AOT indicators, exceedances and different types of stations: EMEP background stations, suburban and urban background stations. The following results concerning the evaluation have been highlighted. Even if the performance of the model is rather good for most stations, unexplained behaviour in some situations (bad correlations for a priori "easy" stations and quite good results for difficult urban ones) shows that choosing appropriate stations for regional air quality model evaluation is difficult. Work remains to define criteria for

measurements selection, and model intercomparisons could contribute to this objective. CHIMERE, which has originally been developed to predict ozone exceedances, performs best for high pollutant levels (around 160-180 $\mu g/m^3$). The work indicates that efforts should be put into improving models for the lower thresholds that are recommended in order to reduce the long-term effects of photo-oxidant pollutants on health and the environment.

26. Mr. M. Millán (Spain) reported on ozone dynamics in the Mediterranean derived from European Union research projects. He presented aircraft measurements showing the changing concentrations when moving from the sea inland, and explained the impact of the interactions between the sea breezes and the upslope winds in the formation of (reservoir) layers of ozone over the sea, and their return inland several days later. He also explained the results of these recirculations: (i) the long residence times of the airmasses located below approximately 3000 m in this region in the summer, i.e. 7 to 10 days for the renewal of 80% of the airmass; and (ii) the observed ozone concentrations, i.e. concentrations exceeding the indicative health protection level of 120 $\mu g/m^3$ some 80 to 120 times per year, but just below the alert level, instead of the peak concentration episodes (exceeding the alert levels) that are more frequent in Central Europe. Finally, he described the difficulties in using current atmospheric dispersion models to simulate the observed recirculations, the layering (nearly impossible to achieve) and thus, the photochemical ozone production in this region.

C. Ozone concentration gradients in the EMEP model

27. In response to a request by the EMEP Steering Body at its twenty-fifth session (EB.AIR/GE.1/2001/2, para. 27), MSC-W presented a note on concentration gradients in the EMEP model. The Steering Body had noted that ozone monitoring was conducted, in line with recommendations, at 3-5 m above the ground, while exposure, for instance of crops, occurred closer to the ground, where different concentrations prevailed. This required some correction of measured ozone.

28. Results from the EMEP models, for example maps of ozone concentrations or AOT40, are intended to be appropriate for a height of about 1 m above the vegetation canopy. As none of the EMEP models uses a vertical resolution which directly produces such a concentration, these values are derived. The following explains the procedure used in the EMEP models to derive these near-ground concentrations of ozone.

29. The EMEP Lagrangian model is formulated as a single-layer model, where a column of air of typically 1-2 km depth is followed along 96-hour trajectories. Concentrations of ozone and other pollutants calculated with this model are therefore essentially averages over this 1-2 km depth. The EMEP Eulerian model has a much greater vertical resolution, with 20 layers up to 100 hPa. The bottom layer has a depth of approximately 100 m, so the model's concentrations can be

regarded as averages over this depth. Neither model predicts directly the ozone concentration for levels of around 1 m. However, assuming that the EMEP model concentrations are appropriate for the top of the so-called surface layer, whose depth is assumed to be around 50 m, then it is relatively straightforward to estimate concentrations at lower levels in the surface layer using well-known boundary-layer theories.

30. To illustrate the importance of this correction factor, table 1 gives both the boundary-layer average and estimated 1-m concentration for a site in Denmark, using meteorological data for 1989. For ozone the change in mean of daily maximum ozone (which corresponds roughly to the afternoon values) is significant, with the derived 1-m concentrations being about 25% lower than the boundary-layer concentrations. For HNO_3, which has the highest deposition velocity (up to 4 cm/s), the corrections are even greater.

Table 1. Comparison of modelled boundary-layer (BL) and derived-surface (1 m) concentrations for the EMEP Lagrangian model. Calculations for Fredriksborg (Denmark) August 1989

Species	**Parameter**	**BL conc. (ppb)**	**1 m conc. (ppb)**
Ozone	Mean of daily max.	42.8	31.6
NO_2	Daily mean	0.71	0.63
HNO_3	Daily mean	1.39	0.21
PAN	Daily mean	0.66	0.49

31. In principle, it is straightforward to apply this methodology for other heights. For example, most monitoring stations are located with an inlet height of around 3 m, so in some cases it may be more appropriate to calculate outputs for such a level. The derived surface of 1 m height is, however, always relative to the so-called displacement height (at about 70% of the height of vegetation). Hence 1 m is not equivalent to 1 m above the ground, but may be higher depending on the vegetation coverage. In addition, the correction factor is necessarily an approximation. It seems appropriate therefore to accept the 1-m concentrations as a reasonable value for "near-surface" ozone concentrations.

32. The Task Force took note of the information presented.

II. EMEP MONITORING PROGRAMME

A. <u>Developing a new monitoring strategy</u>

33. According to its work programme, the Task Force is expected to review and, if necessary, revise the EMEP monitoring strategy. A new monitoring strategy should take into account the long-term strategy of EMEP for 2000 to 2009. Preliminary discussions had been held at the twenty-fifth session of the EMEP Steering Body. CCC presented an overview of the issues to be

taken into consideration.

34. The point of departure should be an analysis of the present situation, including the level of reporting by Parties, new requirements and developments and an evaluation of the most serious data gaps. The measurement programme serves several objectives; one of the primary objectives should be the validation of the EMEP models, but measurements should also help to evaluate the effectiveness of abatement policies. The data should give information on the temporal changes in environmental quality, to be related to emission changes and natural variations. They should inform about the spatial characterization of atmospheric composition and deposition amounts, including subregional features and detailed, site-specific information. They should help to better understand the processes in order to assist model development.

35. Special areas for discussion include the linking of scales (hemispheric, regional, local) and the geographical coverage of EMEP monitoring. One aim should be to improve site-specific deposition and exposure estimates and the optimal site density needs to be determined. New techniques, such as data assimilation, the use of remote-sensing techniques and flux monitoring have to be considered. EMEP should aim at long-term data provision and therefore set a formal requirement for data, while taking into account the financial limitations. Emphasis should be put on ensuring that data quality is known and adequate. A monitoring strategy should therefore address methodology, training and quality assurance.

36. CCC proposed a "level" approach similar to the one developed for particulate matter. Such an approach would be open for the use of relevant data from sources other than EMEP, but would encourage efforts at the national level. Level 1 would be mandatory for all Parties. This should ensure the participation of a large number of sites. It would provide spatial and temporal trends and require continuous sampling. Level 2 would cover advanced measurements at selected sites. It would be more expensive or technically demanding. The data should be process-oriented and provide the basis for the analysis of spatial and temporal trends. Level 2 monitoring could be continuous or limited to campaigns. Level 3 would relate to research data, including data from sources external to EMEP. Level 2 and level 3 sites should be nominated as "EMEP supersites", as this would be an important motivation factor and provide appropriate recognition to the data providers. Supersites could be topic specific and would not need to cover all substances. The geographic distribution of level 2 and 3 sites would need to be carefully examined in order to have good coverage.

37. The Task Force welcomed the presentation by CCC. It supported the main ideas, in particular the proposal to move to a level approach, but it agreed that there was a need for further discussion about the exact definition of levels 2 and 3. Level 1 should take into account the limited resources available. The Task Force recognized that an EMEP monitoring strategy had to strike a

good balance between national and subregional priorities and EMEP requirements. At present, monitoring only partially reflected priorities. Partially it reflected history. It was necessary that all centres together formulated the monitoring requirements for model validation purposes. Led by CCC, they should prepare a report summarizing the present status of reporting and outlining the requirements and priorities. This report would be presented at a workshop of the Task Force in 2003 devoted to the discussion of the monitoring strategy.

38. The Task Force agreed to present this outline to the Steering Body, inviting it to endorse the general approach.

B. Cooperation between EMEP and EIONET on the reporting of monitoring data

39. On 19 and 20 March 2002, a joint session of the seventh EIONET Workshop on Air Quality Management and Assessment and the third meeting of the Task Force was held. The session further discussed the harmonization and streamlining of the reporting of monitoring data between EIONET and EMEP.

40. The European Topic Centre on Air and Climate Change reported on the further development of the Data Exchange Module (DEM). DEM was a data-reporting software widely used for reporting air quality data to the European Commission and EEA. The new version of DEM could export data to the NASA-AMES format and was thus compatible with EMEP data reporting. It had been distributed in November 2001 and therefore not much experience had yet been gained in its use.

41. CCC announced that it would agree to harmonize the reporting date and frequency and suggested moving to an annual reporting of monitoring data by 1 October of each year. CCC confirmed that such a change to a single reporting of monitoring data once a year would not alter its reporting schedule to the EMEP Steering Body provided that all Parties adhered to the new deadline. CCC also pointed out that it was ready to examine the new version of DEM in order to see whether it could receive EMEP data with DEM. CCC would inform the Parties about the exact reporting procedure.

42. The Task Force decided on recommending to the EMEP Steering Body to adopt a new schedule for the reporting of monitoring data. It suggested to CCC to evaluate the experience with the submission of data from Parties using DEM instead of the NASA-AMES software used at present. Based on this evaluation, CCC would propose the recommended formats to be used by Parties for data submission.

III. MODELLING AND MEASUREMENTS OF PARTICULATE MATTER

A. Monitoring of particulate matter

43. EEA presented an overview of the particulate matter (PM) data available in the EIONET AIRBASE database. PM measurements have been conducted at some 580 stations in Europe. AIRBASE includes hourly PM10 data from 335 urban stations. At most of the stations a decrease in PM10 concentrations has been observed in the period from 1997 to 1999. Only few stations have longer time series.

44. CCC reported on progress in the implementation of the PM monitoring programme that had been prepared by the Task Force at its first and second meetings. The programme defines three levels of monitoring: level 1 could eventually cover all EMEP sites, but Parties should start monitoring at least at one of their sites; level 2 consists of a subset of 5-10 EMEP sites with a good distribution over Europe; and level 3 refers to research projects and experimental campaigns (to be recommended by EMEP in consultation with WMO-GAW).

45. After the session of the EMEP Steering Body in September 2001, CCC had sent a questionnaire on the PM monitoring work to Parties and 19 had responded. Based on this response, it can be expected that some 50 sites covering all of Europe will report PM10 data to EMEP in the near future. There is a large variation in the measurement equipment used, which will provide a challenge to the quality assurance work. Eight Parties had announced that they would start monitoring PM2.5. Several stations will contribute data under level 2 and 3 as defined in the monitoring programme, but this will not be sufficient to be able to validate the PM modelling work. CCC will intensify cooperation with other international programmes, such as GAW, JRC and the Nordic PM project, in order to supplement the data that can be expected from EMEP stations.

46. CCC presented a revised draft of chapters 3.15 and 4.21 of the EMEP Manual for Sampling and Chemical Analysis (EMEP/CCC Report 1/95) for measurement of PM10 and chemical speciation of aerosol particles. The draft is based on CEN standard EN 12341. The manual also makes reference to methods for the measurement of PM2.5. Although there is no accepted reference method for PM2.5, several candidate methods exist.

47. Some experts provided comments and corrections to the draft. CCC would incorporate these into the text. The Task Force adopted the revised manual as amended and recommended the EMEP Steering Body to endorse the new Manual.

48. CCC also presented its plans for the elemental carbon/organic carbon (EC/OC) campaign aimed at improving the information on the chemical speciation of PM. The campaign would make efforts to characterize also the organic fraction. Eleven sites in Europe would participate in the campaign, which would be conducted from early summer 2002 and be completed in the summer

2003.

49. The Task Force reminded experts of the high priority that the Executive Body had given to the monitoring of PM. It reiterated its call to Parties to implement at least level 1 of the monitoring programme and to consider contributing additional data. It expressed its support to CCC for its continued efforts to cooperate with other international programmes to supplement the data.

B. Modelling of fine particulates

50. MSC-W reported on the workshop on the implementation of dynamic aerosol models for large-scale applications "Dynamic aerosol modelling: from box models to 3D transport models", held in Helsinki from 30 January to 1 February 2002. The workshop had discussed the outputs that should be expected from aerosol models. For health impact assessments, it had suggested focusing on PM10 and PM1 as well as the chemical composition. It had recommended PM1 instead of PM 2.5 in order to exclude contributions from natural events of dust. The workshop had discussed the main processes necessary for the modelling of the different aerosol properties and the principal areas of uncertainty.

51. The workshop had reached the following conclusions:

(a) Despite the recognized uncertainties in aerosol modelling, it was considered possible to generate useful data from current models. Considerable and intensified attention was required to formulate and test descriptions giving more reliable results;

(b) Initiatives like the GLOREAM model inter-comparison under EUROTRAC2 were welcomed. Further model inter-comparisons and model validation against measurements should be pursued regularly in the initial phase of development of aerosol transport models;

(c) The composition and characteristics of organic aerosols were largely unknown. This lack of knowledge severely limited the possibilities for applying and evaluating secondary organic aerosol models for policy developments.

52. The Task Force took note of the conclusions. It noted that the workshop had shown that it was possible to model PM10 and that this should be a priority. It expressed its doubt about the recommendation to give priority to PM1 over PM2.5. To disregard PM2.5 was not justified from a health perspective, as many recent studies had indicated the relationship between PM2.5 concentrations and health impacts. There were also hardly any PM1 measurements, while the monitoring of PM2.5 was now starting on a broad basis.

IV. MONITORING AND MODELLING OF PERSISTENT ORGANIC POLLUTANTS

A. Measurements of POPs

53. Mr. Knut Breivik of CCC presented the status of POPs measurements. POPs were included in the EMEP monitoring programme in 1999, but already in 1995 a joint measurement database was established in cooperation with other international programmes. The measurement programme now included chlordane, α- and γ-HCH, DDT/DDE, PAHs (19 congeners), 7 PCBs and HCB. In the gas and particle phases, 24 to 48-hour measurements should be made preferably weekly. For precipitation, monthly or weekly measurements are recommended. The most frequent sampling technique for POPs in air is high-volume air samplers. In 1999, four stations in northern Europe reported data on POPs in air to CCC and five did so for POPs in precipitation. There are two stations for which there are HCH data since the early 1990s. For α-HCH these show a clear decrease in air concentrations, while this cannot be observed for γ-HCH. Data available for B[a]P concentrations in air show a clear seasonal variation.

54. The EMEP manual was updated for POPs in 2001. The new version is available on the Internet (www.nilu.no/projects/ccc/manual). A laboratory inter-comparison is under way. The first and the second round have been completed and the results are being evaluated. A workshop with the 13 participating laboratories is scheduled for the second half of the year. The Steering Body had requested Parties, in cooperation with CCC, to establish an EMEP network for POPs. CCC plans to complete this task in the course of 2002 and is looking for support from the Task Force. The programme should include five supersites in the following subregions: Nordic/Baltic region, Northern Atlantic, Continental Europe, Mediterranean, and South Atlantic. At present, the network is limited to Northern and Central Europe.

55. The Task Force took note of the status of POPs monitoring, agreeing that this was not satisfactory. It agreed that it needed to be carefully considered when the monitoring strategy was revised.

56. Ms. E. Brorstroem (Sweden) presented some trends in POP concentrations and fluxes over Northern Europe. She has evaluated data from sites in Pallas (Finland) and Rörvik (Sweden) for the 1989 to 2000 period. The monitoring programme comprises PAHs, PCBs, HCHs, chlordane, DDT and HCB and will be extended by brominated flame-retardants (PBDE). Seasonal variation is observed for several pollutants: PAH levels are highest in the winter, while PCB and HCH levels are highest during the summer. Some trends have been detected. The atmospheric concentrations of PCBs and HCHs on the Swedish west coast have decreased between 1989 and 2000. A comparison of the two sites has revealed that the PAH levels are higher in the south than in the north, while the levels of PCBs and HCHs in Pallas and Rörvik are similar. The greatest amounts of the measured POPs are deposited as a result of long-range air transport and/or with heavy

precipitation.

57. Ms. A.R. Milukaite (Lithuania) presented an assessment of the influence of long-range transport on regional air pollution from organic carbon, B[a]P and soot for a station on the Lithuanian coast. Measurements have been conducted since 1980. She has made trajectory calculations for five sectors for an annual time series from 1980 to 1994 and identified different trends for summer and winter. A special analysis of high-pollution episodes has been made.

58. Mr. I. Holoubek (Czech Republic) reported on POPs monitoring in the Czech Republic, in particular at the station in Kosetice, where POPs were monitored since 1988. He highlighted the usefulness of the data on measurements of pollutants in soil and aquatic and forest ecosystems. He suggested that EMEP should consider moving to integrated monitoring, pointing out that bio-indicators could provide a good data set to validate the EMEP model.

B. EMEP Modelling of POPs

59. MSC-E has made considerable progress in the modelling of POPs. The main results include:

(a) In-depth studies of physical-chemical properties of a number of POPs: PAH, PCDD/F, HCB, PCB and γ-HCH;

(b) A description of the main processes influencing POP transport and accumulation in the atmosphere, soil, seawater, and vegetation;

(c) Data sets for emissions and meteorological and geophysical data for modelling;

(d) A pilot version of a multi-compartment model for the evaluation of POP transport for the EMEP region (with spatial resolution 150x150 km^2 or 50x50 km^2);

(e) A hemispheric version of a model with resolution $2.5^o x 2.5^o$ is being prepared.

60. Modelling results for B[a]P, PCB, PCDD/F, γ-HCH and HCB have made it possible to assess the:

(a) Distribution between environmental compartments (the atmosphere, soil, seawater, vegetation);

(b) Spatial distribution of pollution;

(c) Long-term trends in contamination in the above media;

(d) Media response to emission reductions in PCBs and PCDD/Fs; and

(e) B[a]P transboundary transport,

for the EMEP region. The modelling results have been obtained both for the EMEP region as a whole and for all European countries individually. The country-specific information is placed on the EMEP web page (www.emep.int).

61. The comparison of calculation results with those of the regional model can be considered as reasonable. The comparison of calculated and measured concentrations in environmental media shows that the discrepancy between calculation and measurement data does not exceed an order of magnitude. The main uncertainty is connected with emission data. Model sensitivity studies have revealed that an important part of model uncertainties is related to deposition processes. For better validation of multi-compartment POP models an inter-comparison study of different model types is being organized.

62. The participants of the model inter-comparison study met for the first time during the Task Force meeting. Experts on measurements, emissions and modelling from the Czech Republic, Germany, Lithuania, Sweden, Switzerland, the United Kingdom, the United States as well as CCC and MSC-E attended. The main objective of the study will be to exchange scientific experience, to verify participating models, to contribute to national modelling activities and to compare various models' outputs. Work would start with a review of model approaches and continue with four stages: stage I: process description and parameterization; stage II: mass redistribution between media; stage III: calculated and measured concentrations; and stage IV: evaluation of long-range transport and overall persistence. The study was expected to take two to three years. As a next step, a workshop was planned to be held on 14-15 November in Moscow.

63. Pilot calculations of hemispheric transport of γ-HCH and PCB for 1990 have been performed with the hemispheric version of the EMEP/MSC-E model. The models developed can be used to assess new substances with a view to their possible inclusion in the Protocol on POPs. Both hemispheric modelling and the evaluation of new substances could be an important part of future activities.

64. The Task Force noted with satisfaction the good progress in POPs modelling. It recognized that there was a need to link this work to biological models in order to establish the basis for risk assessments. Work on an effect-based approach seemed not to be progressing sufficiently and the Task Force recommended the EMEP Steering Body to bring this to the attention of the Working Group on Effects and the Working Group on Strategies and Review.

65. The Task Force welcomed the plans for the inter-comparison study and called upon Parties to support the work of national experts.

66. The Task Force noted that, besides the lack of measurements, the quality of emission data was a cause of concern. It recognized that the Task Force on Emission Inventories and Projections had initiated work to provide material to improve national emission data reporting, but it agreed that it was crucial, in the short run, for CCC to continue to support the work on emission data through expert estimates.

67. The Task Force noted with some surprise the large share of hemispheric transport out of the EMEP region shown by the model results. This feature should be further examined by the hemispheric models and the Task Force recommended putting a high priority on the further development of hemispheric modelling.

Short summary of modelling results

68. The results summarized below are based on MSC-E modelling work using expert estimates of emissions.

1. B[a]P

69. About 30% of annual emissions are transported outside the EMEP region. The other B[a]P emissions are mainly distributed between terrestrial and marine compartments. Poland, the Czech Republic and the central part of Russia have high air concentrations (more than 1 ng/m^3) of B[a]P. The number of days with mean diurnal concentrations exceeding a threshold value of 1 ng/m^3 is calculated. At present the main exporters are Poland (14.4 tons/year), the Russian Federation (10.8 tons/year) and the Ukraine (9.5 tons/year).

2. PCB

70. About 50% of annual emissions are transported outside the EMEP region. The remaining emissions are accumulated in terrestrial and marine compartments (70% and 30%, respectively). Germany, Austria, Belgium, the Netherlands, the Czech Republic, Luxembourg and Switzerland have the highest levels of contamination. The air concentrations are in the range of 0.2-1.1 ng/m^3, are averaged soil concentrations are in the range of 2-6 ng/g. Re-emission processes from soils can essentially affect air pollution. In particular at present re-emissions from soils are comparable with anthropogenic emissions. Calculations with a zero emission scenario show that the half-life in soil is 16 years, in sea 12 years, and in air 7 years. A similar half-life in the atmosphere is obtained from the measurements for the United Kingdom.

3. PCDD/Fs

71. The investigation into PCDD/F congener toxicity composition in emissions and in the environment has led to a selection of 8 priority congeners for modelling. The analysis of long-term simulation of 8 selected congeners shows that, with reasonable accuracy (around 50%) for the pilot

simulation, transport and accumulation of PCDD/F can be simulated by the "indicator congener" 2,3,4,7,8-PeCDF.

72. About 60% of the annual emissions are transported outside the EMEP region. Hemispheric/global approaches are feasible for long-range PCDD/F transport evaluation. Due to their long half-lives in soils (from 70 to 100 years) these pollutants tend to accumulate mainly in the terrestrial environment (over 90%). The analysis of partial distributions of PCDD/F contamination in the environment shows that high contamination levels (over 5 fg TEQ/m^3) are characteristic of Central and Eastern Europe. Relatively high soil concentrations in some parts of the Scandinavian Peninsula (up to 5 pg TEQ/g) are explained by the role of forests in the formation of soil contamination. Sea currents play a considerable role in long-range PCDD/F transport. This is illustrated by PCDD/F transport with sea currents to the northern boundaries of the Scandinavian Peninsula. Model calculations of long-range PCDD/F transport for the period from 2000 to 2010, assuming full emission cessation, show that the half-life in soils is about 30 years.

4. HCB

73. Over 80% of annual emissions are transported outside the EMEP region. This shows the need to consider long-range HCB transport on a hemispheric/global scale. Most of the rest of the pollutant is accumulated in the marine environment (about 90%). An analysis of the spatial distribution of HCB contamination shows a homogeneous character of media contamination. Calculated average air concentrations in Europe vary from 40 to 80 pg/m^3 and average seawater concentrations from 4 to 12 ng/m^3. Thus, pollution levels in Europe are to a great extent defined by the pollutant's global transport. Furthermore, calculations show the essential role of marine transport for this pollutant. The analysis of long-term HCB accumulation trends in environmental compartments shows that due to 8-fold emission reductions taking place from 1970 to 1998, air concentrations content over Europe decreased by a factor of 8, there was a 5-fold decrease in soil concentration during this period, and a 3-fold decrease for seawater.

5. g-HCH

74. About 75% of annual emissions are transported outside the EMEP region. The rest is accumulated both in terrestrial and marine compartments (30% and 70%, respectively). The most important accumulation medium is seawater. High air concentrations (0.5-3.5 ng/m^3) are characteristic of France, Portugal, Spain, the Netherlands and Belgium, Germany, Italy, Switzerland and Luxembourg. A nearly four-fold European emission reduction has led to pollution level decreases in environmental media: by about a factor of four in the atmosphere and soil by a factor of two in seawater.

C. Other modelling activities

75. Mr. M. Scheringer (Switzerland) presented work done with the multimedia box models ChemRange and CliCoChem developed for investigating the global fate of POPs. Attention has especially been paid to particles, including their deposition to deep sea, and investigation of temperature-dependent effects. ChemRange model results show that current estimates of rather high degradation rate constants in air, rather low fractions associated with aerosols, and experimentally observed long-range transport of many POPs, are not consistent. It is necessary to improve the understanding of the influence of aerosol particles on the atmospheric fate of POPs. Preliminary studies on the influence of vegetation indicate that vegetation shields the soil from airborne POPs deposition.

76. Mr. P.W. Bartlett (United States) reported on work modelling dioxin transport from North America to the Arctic. The study determined the source-receptor relationships for dioxin emissions from the United States, Canada and Mexico on the deposition in the Arctic, especially looking at the sensitive area of Nunavut with its indigenous population.

77. Mr. K. Jones (Lancaster University, United Kingdom) presented a study on the global cycling and modelling of POPs. The well-characterized PCBs has been used as a case study to consider evidence of global fractionation and redistribution of this family of compounds, which have been present in the environment for many decades. The study distinguished between contributions to the soil and air compartments. A soils database has been established for remote/rural soils across the world. This provides evidence that the bulk of the global emissions of PCBs (in the 30-60° N latitudinal band) has remained close to their source. Passive air samplers are being developed and used for POPs. An example was given where they have been applied on a wide spatial scale in Europe. Data from a 1994-96 deployment was compared with data from 1998-2000. This provided evidence of a decline in the ambient background levels of PCBs in European air, but also indicated that primary emissions still exert a strong control over ambient measurements, despite bans/restrictions having been in place on these compounds since the 1970s. Existing reservoirs of POPs may continue to 'leak' into the environment, potentially dominating over the recycled (secondary) sources.

78. Mr. M. Matthies (Germany) reported on the ELPOS model (Environmental Long-range Transport and Persistence of Organic Substances), which was developed to estimate the potential of emitted chemicals to persist in the environment and to travel over long distances by air and water currents. It was modified from the multimedia box model, which is already part of EUSES (EU System for the Evaluation of Substances), to estimate the regional distribution of new and existing chemicals. The model has been used to model 65 current-use pesticides, 23 industrial chemicals and 21 other persistent chemicals.

V. MOVING FROM LANGRANGIAN TO EULERIAN MODELLING

79. Mr. Anton Eliassen of MSC-W presented some information on the differences in source-receptor relationships between the Lagrangian and present version of the Eulerian models. The Eulerian model at present gives significantly larger deposition due to indigenous sources. This difference is probably to a large extent due to an inconsistency in the dry deposition module, and thus not related the difference in model design. MSC-W is working to resolve the problem. The higher concentrations of nitrate in air in the Lagrangian model is due to a difference in the assumed equilibrium between the gas and the particle phase in the two models. The assumption used in the Eulerian model gives concentrations that fit well with observations. The production rate of sulphate is too low in the Eulerian model, probably due to an underestimation of the cloud-water content, where a large part of this production takes place. MSC-W is working to resolve the problem.

80. Furthermore, the models exhibit differences in the source-receptor relationships, especially for deposition of nitrogen and sulphur, which are due to basic differences in model design. The Eulerian model includes the free troposphere as well as the boundary layer and thus gives a much more complete source attribution than the Lagrangian model. The importance of transport over long distances is therefore higher in the Eulerian model.

81. The unified (photo-oxidants, acid deposition, particle) model is now running in a test version and results are being compared with observations. MSC-W will continue to report on progress in the work on the unified model. The earlier version of the Eulerian acid deposition model will not be developed further.

82. The Task Force took note of the information and agreed to follow the development of the Eulerian model as a matter of high priority.

VI. MODELLING AND MONITORING OF AMMONIA

83. Mr. T. Dore (United Kingdom) presented results of modelling dispersion and deposition of ammonia over the British Isles. The study used a multi-layer Lagrangian model (FRAME) with a 5 km x 5 km resolution to investigate the spatial variation of NH_3 concentration and wet and dry deposition of NH_x across the United Kingdom. The model showed good correlation with measurements of NH_x wet deposition and with measurements of NH_4^+ aerosol concentrations. The modelled concentrations of NH_3 showed considerable scatter when correlated with measurements due to the strong variation of NH_3 concentrations within a 5 km grid square. A 14% reduction in NH_3 emissions projected by 2010 would result in a decrease in the percentage of grid squares where the critical level of 8 $\mu g/m^3$ were exceeded from 2.2% for 1996 to 1.2%.

84. Mr. M. Sutton (United Kingdom) presented the approach to, and methods used for, ammonia monitoring in the United Kingdom. He reported that a 3-level approach was used. Level 1 consists of monthly monitoring of NH_3 and NH_4^+ concentrations (at over 80 sites for NH_3 and 35 sites for NH_4^+) for the assessment of spatial patterns and long-term trends. A low-cost denuder system had been developed for the separate sampling of aerosol and gas. Level 2 comprises weekly/monthly monitoring of NH_3 concentrations and dry deposition (at 4 sites), for comparison with model deposition estimates. The conditional time-averaged gradient (TAG) system is used. Level 3 consists of long-term and campaign process studies on NH_3 and NH_4^+ dry deposition and chemical interactions. Sampling is conducted on a half-hourly basis to quantify fluxes and processes for the development and parameterization of models. It was noted that level 1 methods could be easily applied at other sites in Europe, and would provide a means of assessing NH_3 and NH_4^+ trends at much lower cost than current daily sampling methods. Mr. Sutton offered to share the technology with other interested Parties. The lack of long-term NH_3 and NH_4^+ data for trend assessment across Europe was highlighted as being a key concern. The spatial pattern of NH_3 is highly variable, making site characterization and sampling at many sites important. Conversely, the spatial variability of NH_4^+ aerosol is much less. Seasonal profiles of NH_3 concentrations were different according to the locally dominant NH_3 source sector. High NH_3 concentrations were observed also in urban areas resulting from a wide range of non-agricultural sources. Higher aerosol NH_4^+ concentrations were observed in cities, reflecting the effect of NH_3 emissions on PM concentrations.

85. Mr. R. Ballaman (Switzerland) informed the Task Force about ammonia monitoring and modelling work in Switzerland. Passive samplers were used for the measurement of the ammonia concentration (14-day sampling period) since autumn 1999 at 25 sites. They show a very high correlation with the calculated concentrations based on a detailed emission inventory (100 m x 100 m grid). The ammonia concentrations are affected: (a) by the proximity of the source (farm stable, spreading of liquid manure, human activities, road traffic); (b) by the vicinity of trees (filtering out of ammonia by the foliage); and (c) meteorological parameters (mainly air temperature and humidity). The annual quantity of nitrogen deposited by dry deposition of gaseous ammonia is estimated to be up to 14 kg N/ha on the land and up to 35 kg N/ha in the forest. This means that dry deposition of ammonia alone already leads to an exceedance of critical loads for forests.

86. The Task Force took note with appreciation of the information provided and agreed that it would take this information into account in its work to revise the monitoring strategy and continue its cooperation with the ammonia expert group. The Task Force welcomed the offer by M. Sutton. CCC would work to include the methods in the EMEP Monitoring Manual. It also recommended to report data of filter stack measurements of nitrogen compounds separately, including HNO_3 (gas), NO_3 (particle), NH_3 (gas) and NH_4 (particle).

VII. FURTHER WORK

87. Based upon its terms of reference and its work programme up to 2004, the Task Force discussed the priorities for work in 2004. The following priorities for work in 2003 were highlighted:

(a) Further work on the assessment report in close collaboration with national experts;

(b) Discussion of progress in the work at MSC-W on the Eulerian unified model and its validation;

(c) Revision of the monitoring strategy, including a better link between modelling and measurements.

88. The Task Force recognized the urgency of work to validate the unified Eulerian model and the need for this work to be ready by the time its meeting in spring 2003 so that the results could be presented for approval to the Steering Body in September 2003.

89. The secretariat informed the Task Force about a proposal by the Bureau to reorganize the reporting by the centres. Once the EMEP Steering Body had adopted this proposal, the EMEP task forces would have a much greater responsibility to review the work of the centres. The Task Force on Measurements and Modelling would, in particular, be requested to review the technical and scientific reports and notes prepared by the centres. The proposal also foresaw that experts nominated for the task forces would approve data reports. The Task Force recognized that for monitoring, in contrast to emissions and integrated assessment modelling, there were no focal points nominated and this needed to be considered when this proposal was to be discussed. It also recognized that the role of quality assurance managers should be taken into account.

90. A workshop of the Task Force focusing on the assessment report would be held in the first week of November 2002 in Vienna. The next meeting of the Task Force was scheduled for March 2003 in Valencia (Spain). The Chairperson would investigate the possibility of holding this meeting in conjunction with another body.