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## 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)

#### Thirty-fourth session

Geneva, 13–15 2010

Item 6 (a) of the provisional agenda

**Progress in activities in 2010 and future work: Measurements and modelling (acidification, eutrophication, photo-oxidants, heavy metals, particulate matter and persistent organic pollutants)**

## Measurements and Modelling

### Introduction

1. The present report presents the results of the eleventh meeting of the Task Force on Measurements and Modelling, held on 13 and 14 May 2010 in Larnaca, Cyprus, in accordance with item 2.2 of the workplan approved by the Executive Body at its twenty-seventh session (ECE/EB.AIR/99/Add.2). It describes progress in the heavy metals pilot study and in the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) field campaigns' analysis and feedback related to the effective implementation of the revised EMEP monitoring strategy, as well as ongoing work on modelling aspects.

2. A scientific workshop on sensitive issues in the emission, measurement and modelling fields, jointly organized by the Task Force on Measurements and Modelling and the Task Force on Emission Inventories and Projections, was held on 12 May 2010. The presentations made during those meetings and the report presented can be accessed online at: <http://www.nilu.no/projects/ccc/tfmm/>.

3. Sixty-five experts from the following Parties to the Convention attended the meeting of the Task Force: Belarus, Belgium, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, the Netherlands, Norway, Portugal, the Russian Federation, the Slovak Republic, Spain, Sweden, Switzerland, Ukraine and the United Kingdom of Great Britain and Northern Ireland. Also present were representatives from the Chemical Coordinating Centre (CCC), the Meteorological Synthesizing Centre-East (MSC-E), the Meteorological Synthesizing Centre-West (MSC-W), the European

Environment Agency (EEA), the European Commission's Joint Research Centre (DG-JCR), the World Meteorological Organization (WMO) and CONCAWE (the oil companies' European association for environment, health and safety in refining and distribution).

4. Ms. L. Rouil (France) chaired the meeting, which was hosted by the Cypriot Ministry of Labour and Social Insurance (Department of Labour Inspection). Ms. Rouil gave a short presentation with an outline of the work done in 2009 and currently in progress within the Convention on Long-range Transboundary Air Pollution with regard to the ongoing revision of its protocols.

## **I. Heavy metals issues**

### **A. The test case studies**

5. A representative of MSC-East presented the rationale and the framework of the heavy metal test case studies launched in 2010 for an in-depth investigation of the inconsistencies between heavy metal emissions, measurement and modelling in several European countries. At present, six countries (Croatia, the Czech Republic, Italy, the Netherlands, Slovakia and Spain) had expressed their interest in participating in the project. Recommendations for further improvement of air quality assessment (emission data, model parameterization, quality and representativeness of monitoring data, etc.) were expected as the main results of those test case studies.

6. He noted that the project had been organized in several work packages: collection of data (emissions, observations, etc.); preparation of input geophysical and meteorological data for modelling; atmospheric modelling; analysis; and interpretation. MSC-East and country involvement could differ according to the availability of data (inputs for modelling and observations), modelling results from potential national projects, national skills and resources. A detailed workplan had been proposed and agreed by the Task Force. The project should be achieved by the beginning of 2012 with the publication of assessment reports and recommendations.

7. Questionnaires had been sent to the volunteer countries to assess their specific situation in terms of available information and experience, and the representative of MSC-East presented a first assessment. Results from a bilateral meeting between the EMEP Centre and the experts from the Czech Republic, organized in April 2010, were also reported.

8. The six countries involved in the project presented their experience and their expectations related to the project. The wealth of data available through national initiatives was highlighted. A detailed description of observed discrepancies between measurement and modelling of some heavy metal compounds was provided by the country representatives, as well as the potential sources of uncertainties to be investigated within the pilot studies.

9. The Task Force welcomed the workplan proposed by MSC-East and acknowledged the volunteer countries participation in the test case studies. In particular, the Task Force highlighted its interest in the initiative and its relevance for improving emission inventory data, model parameterizations and optimizing the monitoring network. The Task Force highlighted that special care should be given to the evaluation of the model performances using robust and simple metrics.

10. The Task Force noted that MSC-East would present the status of the pilot studies at the thirty-fourth session of the EMEP Steering Body, in September 2010. Work progress should be presented at the next Task Force annual meeting, in spring 2011.

## **B. Presentation from Ukraine**

11. A representative from Ukraine presented a complete overview of the work done so far in preparation for Ukraine's ratification of the Heavy Metals protocol, including improvement of its emission inventory processes, updating of its monitoring strategy and development of a new national model for mapping air concentrations and deposition of heavy metals.

12. The Task Force expressed its satisfaction with the work done by Ukrainian specialists and recommended that the information be submitted to the EMEP Steering Body at its thirty-fourth session for approval as a fulfilment of the mandatory contribution in-kind to EMEP. The main part of the work provided useful information for EMEP on emission inventories of heavy metals and national modelling in the Ukraine.

## **II. Issues related to the implementation of the revised EMEP monitoring strategy**

13. As an introduction, a representative of CCC gave a presentation of actions in progress in order to improve data provision. As the availability of monitoring data for EMEP parties and other uses and collaboration with other monitoring programmes were fundamental for the revised EMEP monitoring strategy, securing the data provision pathways became a crucial point.

14. He detailed the various international initiatives dedicated to observation data compilation and dissemination whether they were borne by research projects (GEOMON — Global Earth Observation and Monitoring; the Sixth European Research Framework Programme), research networks (the European Supersites for Atmospheric Aerosol Research (EUSAAR), the European Aerosol Research Lidar Network (EARLINET), the Integrated Carbon Observation System (ICOS), etc.) or regulatory issues and international monitoring programmes (EMEP, the European Environment Agency (EEA), the OSPAR Commission, the Baltic Marine Environment Protection Commission (HELCOM), the World Meteorological Organization/Global Atmospheric Watch (WMO GAW)). He noted that one of the most comprehensive and secured global air pollution database was available through the EMEP programme and the Task Force on Hemispheric Transport of Air Pollution.

15. The representative of the CCC then provided an update on the cooperative project built up with the EEA on Near Real Time (NRT) transmission and dissemination of monitoring data. The EMEP programme was supposed to facilitate access to such NRT data, as a contribution to the Global Monitoring for Environment and Security (GMES) programme. He also mentioned the collaboration with the GAW World Data Centre for Aerosols (WDCA) for the dissemination of NRT aerosol parameters. The Task Force noted how CCC, and more genuinely the Norwegian Institute for Air Research (NILU) activity was well focused on the collection and dissemination of NRT research data which required special care in terms of format, flagging and validation procedures.

16. Finally the representative of CCC drew attention to the Aerosols, Clouds and Trace Gases Research Infrastructure Network (ACTRIS) project starting in 2010 and where NILU was involved. It aimed at integrating the key ground-based facilities for long-term observation of aerosols, cloud-aerosol interactions and trace gases in Europe. The Task Force took note of that information, observing that such a European-wide cooperation framework was likely to serve EMEP objectives.

## A. EMEP intensive field campaigns

17. A representative from CCC presented the first consolidated results from the recent EMEP field campaigns (2006–2009) and the current status of the collected data. The EMEP programme had two intensive measurement periods — one in 2008 (17 September–15 October), and one in 2009 (25 February–26 March) — with the aim of studying aerosol (gas/particles conversion, size distribution, carbonaceous aerosol). In total, 18 sites had participated in the field campaigns with a remarkable geographical coverage, and 9 of them had carbonaceous aerosol source apportionment in their programme (filter or 14C analysis). At four of the Northern European sites chemical composition of the carbonaceous aerosols had been performed. Data reporting was making good progress even if some technical aspects still needed to be covered (e.g., analysis of mineral dust).

18. The Task Force acknowledged the very interesting results available from that successful initiative and acknowledged the work done by the CCC to release them to the Parties as quickly as possible through the EBAS website (<http://ebas.nilu.no/>). It stressed the importance of such experiments in establishing reporting guidelines and quality assurance/quality control (QA/QC) procedures for the EMEP community. The Task Force further welcomed the fact that — based on the results from the intensive campaigns — several scientific papers from the community were in preparation.

19. In addition, the Task Force was informed by an expert from the Centre of Ecology and Hydrology of Edinburgh about the new perspectives, in terms of characterization of particulate matter (PM) composition and mass size distribution, brought about by the new Aerosol Mass Spectrometer (AMS) technology that had been implemented at around 10 sites during the EMEP field campaigns. He stressed the great interest of AMS data for model evaluation and improvement, provided that the observation data were correctly interpreted.

20. An expert from the Paul Scherrer Institute (PSI) from Zurich showed how data measured by the AMS could be used for identifying organic aerosol from local and transboundary sources and quantifying their contribution to aerosol mass concentration thanks to source apportionment (Positive Matrix Factors (PMF)) techniques.

21. An expert from the Joint Research Centre (JRC) reported on progress in the development of a reference method in the EUSAAR project for elemental carbon/organic carbon (EC/OC) detection. It was recommended: (a) to use a denuder to avoid positive OC artefacts; and (b) to use a quartz fibre filter to avoid negative artefacts connected with volatile organic compounds. The Task Force was also informed about the work in progress at the European Committee for Standardization (CEN) working group on EC/OC, for the establishment of a reference method for EC/OC thermo-optical analysis, consistent with the EUSAAR2 protocol. Finally the Task Force was updated on the results from the latest OC, EC and total carbon (TC) intercalibration experiment (2009) organized by the JRC and involving 12 EUSAAR project participants. It was noted that overestimation of total carbon could be quite large compared to the reference values, and the comparison could be even worse considering EC/TC ratios. The next intercomparison exercise would be organized in 2010 and the experts in charge of the EMEP stations reporting EC/OC values were invited to participate.

22. In a discussion about the priorities for the next EMEP field campaigns that followed the following conclusions were reached:

(a) Focus on PM composition and sources characterization would be the main issues covered by the intensive observation periods;

(b) A real added value could be achieved if the intensive observation periods matched those selected for other monitoring projects (e.g., the Chemistry-Aerosol

Mediterranean Experiment (CHARMEX) or the Clean Air for London (ClearFlo)) and if close cooperation could be formalized with other networks, such as EARLINET or ACTRIS. For that reason, it seemed that the year 2012 should be addressed. The Task Force proposed that the next field campaigns could be set up in 2012–2013 — a proposal to be discussed by the EMEP Steering Body at its thirty-fourth session;

(c) The powerful AMS tools should be extensively used in the next field campaigns. It was noted that there the AMS community in Europe was growing and was ready to contribute to the EMEP monitoring strategy. Moreover new devices, less expensive but with interesting capacities for aerosol speciation and source apportionment, should be tested — in particular mini-AMS and multi-wavelength aethalometers which were well suited to longer-time experiments (six months) were identified for further investigation;

(d) The summer and winter intensive periods should be defined with a new distribution of the measurement sites. It was recommended to implement pairs of urban/rural sites. The need for collocated measurement of new compounds, especially trace gases (volatile organic compounds, nitrogen oxide (NO<sub>x</sub>), sulphur oxide (SO<sub>x</sub>), ammonia (NH<sub>3</sub>), nitric acid (HNO<sub>3</sub>), etc.) was also mentioned;

(e) Close cooperation with the modelling community and taking into account the lessons learned from the previous field campaigns should be the driving lines for the preparation of the next EMEP field campaigns.

23. It was decided that the detailed workplan for the future EMEP field campaigns would be discussed by the Task Force at its next annual meeting in spring 2011.

## **B. Implementation of the EMEP monitoring strategy and cooperation with the Parties**

24. CCC reported on the implementation of the updated EMEP monitoring strategy by Parties. The following issues were highlighted:

(a) It was taking some time to change national priorities, and awareness of the Convention requirements might be limited from some decision makers' point of view;

(b) Consequently, some countries performed a lot of measurements which were not closely linked to EMEP; interaction with other monitoring programmes (GAW) and with other European regulatory monitoring processes (the Air Quality Directive especially) was essential;

(c) On the other hand, the great interest for the EMEP programme from non-official contributors (the research community) was remarkable and could bring added value.

25. Only eight Parties had responded to the CCC consultation on the status of the implementation of the revised strategy. The main challenge was limited funding for implementation and politically driven interest in the measurements agenda. CCC proposed its support to promote the EMEP programme at country level. It could include the delivery of support letters to national experts, courses and training sessions on EMEP methodologies. CCC could also initiate technical exchanges between national agencies and research groups. Participants expressed the need for diverse sources of funding because the funds allocated by national authorities for the EMEP programme alone were not sufficient, stressing that such diverse sources needed to be stable enough to maintain the continuity and the quality standards of the monitoring programmes.

26. Representatives from Germany presented the work and the results obtained from the monitoring programme that had been held at the Melpitz EMEP station. Size-segregated characterization of PM<sub>10</sub> was possible with five-stages Berner-impactors. The distribution of those characteristics according to the origin of air masses was presented. An online monitor device for aerosols and gases in ambient air (MARGA) had been implemented on the monitoring site as well. An impressive collection of time series and data related to aerosol and gaseous compounds was presented, together with relevant and instructive comparisons with other measurement techniques.

27. The representative of Switzerland gave an overview of the work done at the Swiss Federal Laboratories for Materials Testing and Research (EMPA) for comparing the TEOM-FDMS (tapered element oscillating microbalance-filter dynamics measurement system) PM measurement method with reference one (according to European Commission Air Quality Directive 2008/50/EC), based on gravimetry. That point was very sensitive for the implementation of the PM monitoring strategy in Europe and discrepancies could be found depending on the material used in the TEOM-FDMS devices and the location. The Air Quality Reference Laboratories in Europe (AQUILA) had prescribed a number of recommendations for safe use of that technique, which should be carefully considered in the EMEP monitoring strategy.

28. The representative of the United Kingdom presented the ClearFlo programme (2010–2013), which aimed at establishing an appropriate monitoring infrastructure for meteorology, and atmospheric gaseous and aerosol composition. Several intensive observation periods would be set up for characterizing the determinant factors of air pollution in London and to evaluate the operational models running in the United Kingdom.

### **III. Modelling issues**

#### **A. Status of the MSC-West projects and national contributions**

29. Representatives of MSC-West presented their latest modelling results, especially those related to PM concentrations' prediction. The status of development of a secondary organic aerosol (SOA) module based on a volatility basis set concept in the EMEP model and its preliminary evaluation had been commented. Encouraging results had been shown. MSC-West also reported on the progress with inorganic PM modelling. The main aspect of the presentation was on the role of change in meteorological driver of the model (HIRLAM was now used instead of PARLAM). It caused more turbulent mixing (faster aloft transport), bias in wind velocity and precipitation anomalies responsible for significant changes in dry and wet deposition. The Task Force stressed the high sensitivity of the modelling results to the meteorological driver and recommended further investigation to assess its impact for policy purposes. The need for the definition of appropriate metrics for model evaluation was highlighted as well.

30. Four presentations from national representatives allowed the Task Force to consider the modelling activities developed by Parties:

(a) A representative of Italy presented a comparison of several schemes of observational data assimilation in the Transport and Chemical Aerosol (TCAM) model;

(b) A representative of Croatia presented air pollution model results obtained with the EMEP model on the country domain for base year 2006 and 10x10 km emission data set. Several scenarios were modelled (with different sets of national emissions);

(c) A representative of Cyprus presented the air quality control and public awareness systems in Cyprus, providing air quality maps and forecasts based on the MEMO and MARS-Aero modelling tools;

(d) A representative of the United Kingdom presented results from an uncertainty analysis in ozone models, with a focus on a Monte Carlo analysis of the chemical module. That study demonstrated the potential high level of uncertainty in ozone modelling.

## **B. The Eurodelta3 project**

31. A representative of JRC presented the Air Quality Model Evaluation International Initiative (AQMEII) (<http://aqmeii.jrc.ec.europa.eu>) which aimed to promote research on regional air quality model evaluation across the European and North American atmospheric modelling communities, through the exchange of information on practices, the realization of inter-community activities and the identification of research priorities, keeping in focus policy needs. AQMEII should provide the opportunity to enhance scientific activity and exchanges on model evaluation thanks to a real web service dedicated to that task. The Task Force welcomed that project, in which several national experts from the Task Force were involved.

32. Another representative of JRC presented the rationale and the workplan of the new phase of the Eurodelta model (named Eurodelta3) intercomparison project which should be developed within the Task Force framework. Two kinds of model studies had been agreed:

(a) A task was devoted to model evaluation against well documented datasets issued from the EMEP field campaigns with the objective of improving physico-chemical parameterizations in the model. The main difficulty was figuring out how to derive correct interpretations of complex measurement data available from field campaigns regarding the variables and indicators computed by the modelling tools;

(b) The other task relied on longer-term trends analysis, with the evaluation of the ability of models to reproduce changes in emissions in a retrospective perspective. Three full years should be considered: 1990, 1999 and 2006. For that task, difficulties could be encountered for the acquisition of consistent input datasets, especially for emissions and meteorology.

33. An expert from the Centre of Ecology and Hydrology of Edinburgh gave an overview of selected data available from the previous EMEP/European integrated projection aerosol cloud climate air quality interactions (EUCAARI) field campaigns well suited to model evaluation. He highlighted the need for feedback from the measurement community for the correct interpretation of the observation and as an example proposed a tentative correspondence table between the AMS measured components and model components. The Task Force acknowledged that initiative and encouraged its experts from both the modelling and the measurement communities to establish close links for improving transboundary air pollution assessment.

34. The representatives of six countries that had agreed to participate to the Eurodelta3 project (among the 10 groups which had expressed their interest) presented the main characteristics and performances of their models. Those tools were MATCH (Sweden), CHIMERE (France), EMEP (MSC-West), RCG (Germany), CAMx5 (Switzerland) and LOTOS-EUROS (the Netherlands).

35. The Task Force expressed its support to the Eurodelta3 project and agreed with the workplan proposed by the JRC. The Task Force made the following decisions to ensure good and efficient development within the project:

(a) Coordination with the AQMEII initiative should be formally established to avoid duplication of work and to take mutual benefits of both projects (for instance the year 2006 should be studied in both of them);

(b) The Eurodelta3 project should participate in a new evaluation of the EMEP model used for policy purposes;

(c) The Eurodelta3 project should work to foster the wealth of observation data available from the EMEP/EUCAARI field campaigns and should help in the definition of the future monitoring priorities;

(d) Special care should be given to the interpretation of the Eurodelta 3 results for improving integrated assessment modelling and contributing to the reduction of uncertainties in that process.

36. The Task Force validated the following workplan for the Eurodelta3 project:

(a) 2010: preparation of input data for the simulation of the three targeted years for the retrospective analysis and the intensive observation periods. Two small working groups should be formed with volunteering members of the Task Force and with external experts or researchers. The first one would be devoted to the definition of the objectives of the model evaluation against field campaigns data, including observation data selection, formatting, etc. The other would be focused on input data collection, scaling and consolidation, including emissions, meteorology, land cover and boundary conditions. The first runs should be launched by the end of the year;

(b) 2011: runs, analysis of the results, sensitivity studies, recommendations for model improvement and for use in integrated assessment modelling;

(c) The workplan and project set-up should be presented to the EMEP Steering Body at its thirty-fourth session in September 2010, and preliminary results should be discussed at the next annual Task Force meeting in spring 2011.

#### **IV. Future work**

37. Following discussion on the activities to be reflected in the 2011 workplan of the EMEP Steering Body, the Task Force agreed to propose the following work items for 2011:

(a) Build up the appropriate framework and support for the implementation of the updated EMEP monitoring strategy, by undertaking the following actions:

(i) Assistance and exchange of experiences in order to clarify and facilitate implementation of the revised monitoring strategy; (CCC/Task Force/Parties)

(ii) Enhancing the dialogue with the satellite and remote-sensing community, through setting up a joint working group including Task Force members and experts from that community.

(b) Contribute to the analysis and promotion of the EMEP field measurement campaigns; encourage utilization of their results, in collaboration with CCC; invite Parties to use relevant data for national air quality assessments and analyses; (CCC/Parties/Task Force)

(c) Contribute to the development of a framework and a workplan for the next EMEP field campaigns scheduled for winter and summer periods in 2012 and 2013, respectively. Present the draft workplan to the EMEP Steering Body at its thirty-fifth session in 2011; (CCC/Task Force)

(d) Provide guidance for the implementation of the six case studies on heavy metal pollution assessment (in the Czech Republic, Croatia, the Netherlands, Spain, Italy, Slovakia), which aims at bringing together the know-how for policy support from emission, measurement and modelling communities; assess and analyse the results and overall success of the exercise; (MSC-E/Task Force)

(e) Organize and coordinate the EURODELTA follow-up modelling exercise with the assistance of the Joint Research Centre (JRC) of the European Union, focusing on the evaluation of the ability of models (especially the EMEP model) to simulate fine resolution atmospheric processes, with the emphasis on the development of common model intercomparison protocols, model-to-observation performance indicators and criteria needed for to evaluation of the state of the art of the EMEP model, as well as its ability to reproduce past trends in air pollutant concentrations;

(f) Report on progress at the thirty-fifth session of the EMEP Steering Body; (Task Force/MS-C/W/CCC/Parties)

(g) Contribute to the ongoing European Union modelling initiatives (e.g., the European Consortium for Modelling of Air Pollution and Climate Strategies (EC4MACS), the EEA Forum for Air Pollution Modelling (FAIRMODE) and the Air Quality Model Evaluation International Initiative (AQMEII));

(h) Consider options and opportunities for enhancing the visibility and promotion of the work of the Task Force on Measurement and Modelling (e.g., by means of newsletters, conferences); (Task Force, Parties, Centres)

(i) Hold its twelfth meeting in May 2011 in Zurich, Switzerland and report on its outcomes to the EMEP Steering Body at its thirty-fifth session in 2011.

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