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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-fifth session**

Geneva, 5–7 September 2011

Item 6 (d) of the provisional agenda

**Progress in activities in 2011 and future work:  
hemispheric air pollution**

### **Hemispheric transport of air pollution**

**Report prepared by the co-Chairs of the Task Force on Hemispheric  
Transport of Air Pollution**

#### **I. Introduction**

1. The Task Force on Hemispheric Transport of Air Pollution (Task Force) completed the first comprehensive assessment of intercontinental transport of air pollution across the Northern Hemisphere in 2010, referred to hereinafter as *HTAP 2010*.<sup>1</sup> After receiving the report with appreciation, the Executive Body for the Convention on Long-range Transboundary Air Pollution (Air Convention) revised and expanded the mandate of the Task Force to:

(a) Continue to examine the transport of air pollution across the Northern Hemisphere, with an explicit mention of ozone and its precursors and particulate matter (PM) and its components (including black carbon);

(b) Identify emission mitigation opportunities available inside and outside the United Nations Economic Commission for Europe (UNECE);

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<sup>1</sup> United Nations Economic Commission for Europe, *Hemispheric Transport of Air Pollution 2010* (ECE/EB.AIR/0100-0103; to be issued shortly).

(c) Assess the impacts of those mitigation opportunities on regional and global air quality, public health, ecosystems and climate change;

(Executive Body decision 2010/1, ECE/EB.AIR/106/Add.1).

2. In carrying out these tasks, the Executive Body explicitly directed the Task Force to cooperate as appropriate with other subsidiary bodies of the Convention (including the Expert Group on Techno-Economic Issues, the Task Force on Integrated Assessment Modelling, the Task Force on Emissions Inventories and Projections, the Task Force on Measurements and Modelling and the Working Group on Effects) and with efforts outside the Convention (including by the Arctic Monitoring and Assessment Programme (AMAP), the United Nations Environment Programme (UNEP) and the Intergovernmental Panel on Climate Change (IPCC)).

3. The Executive Body requested the Task Force to develop a multi-year workplan for submission to the Steering Body to the Cooperative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe (EMEP) as part of the workplan of the Convention. This report presents the first draft of the 2011–2015 workplan for the Task Force addressing the revised mandate. It is expected that this workplan will continue to evolve based on input from the EMEP Steering Body and the Convention's Executive Body, as well as other subsidiary bodies under the Convention and the science and policy communities engaged in the Task Force.

4. The European Union (EU) and the United States of America are the lead Parties for the Task Force. Since its formation in 2005, the Task Force has been co-chaired on behalf of the lead parties by Mr. André Zuber of the European Commission's Directorate General for the Environment and Mr. Terry Keating of the United States Environmental Protection Agency. Due to other professional responsibilities, Mr. Zuber has asked Mr. Frank Dentener of the European Commission's Joint Research Centre (JRC) to assume the co-chair role on behalf of the EU.

## II. Seventh annual meeting

5. This draft workplan is based mainly on the discussions at the seventh annual meeting of the Task Force held in Arona, Italy, from 6 to 9 June 2011. The meeting was hosted by JRC and was attended by more than 65 experts from Belgium, China, the Czech Republic, France, Germany, Greece, India, Italy Japan, Mexico, the Netherlands, Norway, Pakistan, the Russian Federation, Spain, Sweden, Thailand, the United Kingdom of Great Britain and Northern Ireland and the United States. Representatives from the Meteorological Synthesizing Centre-East (MSC-E), the Meteorological Synthesizing Centre-West (MSC-W), the Chemical Coordinating Centre (CCC), the Centre for Integrated Assessment Modelling (CIAM), JRC, the European Environment Agency (EEA) and UNEP also attended.

6. The main objectives of the meeting were to:

(a) Review the decisions of the Air Convention with respect to the findings of *HTAP 2010* and the revised mandate for the Task Force, in particular related to widening the scope of work to include short-lived climate forcing of air pollution and analysis of mitigation options;

(b) Take stock of ongoing and planned science and assessment efforts related to intercontinental transport and interlinkages with climate change, upon which future work of the Task Force could build;

(c) Formulate a new set of policy-relevant science questions in view of the revised mandate of the Task Force;

(d) Outline a multi-year workplan for the Task Force to address those questions that involved EMEP bodies and task forces and other national and international organizations.

7. The presentation materials from the meeting are available at [www.htap.org](http://www.htap.org). The main outcomes of the discussions of future work are summarized in the following sections.

### **III. Objectives of cooperative activities**

8. The Executive Body's direction to the Task Force in decision 2010/1 identifies objectives for the Task Force's activities as well as some specific tasks. For purposes of developing the multi-year workplan, it is helpful to separate the overall objectives of the Task Force from the more specific tasks or questions it has been charged with answering. Drawing upon decision 2010/1, the following objectives for the Task Force's future work were identified:

(a) Deliver policy-relevant information regarding the intercontinental transport of air pollution and the linkages between regional air pollution and global change. The primary audience for this information is the EMEP Steering Body and the Air Convention. However, the work of the Task Force may provide information that is relevant to global institutions, such as UNEP, IPCC, or the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention); other regional air pollution efforts, such as the Network for Acid Deposition Monitoring in East Asia (EANET) and the Malé Declaration on Control and Prevention of Air Pollution and its Likely Transboundary Effects for South Asia; and national Governments;

(b) Improve the scientific understanding of the intercontinental transport of air pollution and the linkages between regional air pollution and global change. Scientific understanding of these issues is evolving rapidly through many related national and international research programmes. The Task Force can help contribute to this development by organizing coordinated research efforts that fill critical gaps, by providing a common meeting ground for related efforts, and by helping to integrate information from scientific efforts addressing these issues from different perspectives;

(c) Build a common understanding of the intercontinental transport of air pollution and the linkages between regional air pollution and global change that may serve as a foundation for cooperative action at the hemispheric or global scale. The Task Force will build this common understanding by continuing to engage experts from inside and outside the Convention, and coordinating its work with other regional cooperative efforts and international institutions. While maintaining a focus on the intercontinental scale, the Task Force will strive to produce consistent technical information and tools that can support air quality management at the local and regional scales both inside and outside the Air Convention and to lower the barriers to participation in the cooperative work of the Task Force.

### **IV. Guiding policy-relevant questions**

9. As a main objective of the Task Force is to deliver policy-relevant information, it is important to identify the key policy-relevant questions of interest to the policy audiences identified above. These key questions can then be used as a guide to the technical and scientific work of the Task Force. At the first meeting of the Task Force, in June 2005, a

similar set of questions were identified that guided the first phase of the Task Force's work. This first set of questions focused almost exclusively on the ability to define source-receptor relationships on the intercontinental scale. In developing *HTAP 2010*, it was also useful to look at intercontinental transport in terms of source attribution of regional pollution and the potential value of global cooperation versus regional cooperation in achieving air quality goals. Thus, to guide the efforts to deliver policy-relevant information in the next phase of work, the following questions were identified:

- (a) In different continental or subcontinental regions of the world, what fraction of air pollution concentrations, deposition and impacts to human health, ecosystems and climate change can be attributed to sources of contemporary anthropogenic emissions within the region as compared to extraregional, non-anthropogenic, or legacy sources of pollution?
  - (i) For ozone, what is the relative contribution of regional anthropogenic emissions of non-methane precursors, anthropogenic emissions of non-methane precursors in other regions, global methane emissions, stratospheric intrusion and biogenic emissions?
  - (ii) For particulate matter, what is the relative contribution of regional anthropogenic emissions, anthropogenic emissions in other regions, open biomass burning emissions, biogenic, wind-blown dust or other geogenic emissions?
  - (iii) For mercury, what is the relative contribution of contemporary regional anthropogenic emissions, contemporary anthropogenic emissions in other regions, biogenic or geogenic emissions, or re-emitted mercury that was previously deposited from past anthropogenic emissions?
  - (iv) For persistent organic pollutants (POPs), what is the relative contribution of contemporary regional anthropogenic emissions, contemporary anthropogenic emissions in other regions, or re-emitted POPs that were previously deposited from past anthropogenic emissions?
  - (v) How do the magnitudes of these fractions differ in different regions of the world and how have they changed over time?
  - (vi) How do the magnitudes of these fractions vary across continental or subcontinental domains and how do they vary by month or between years?
  - (vii) How do the magnitudes of pollution flows into continental or subcontinental domains (i.e., regional boundary conditions) differ in different regions?
- (b) How sensitive are regional pollution levels and related impacts to changes in the sources of the various fractions identified above?
  - (i) What is the value of global cooperation as expressed in terms of the relative sensitivities of regional pollution levels or related impacts to the control of regional and extraregional contemporary anthropogenic emission sources?
  - (ii) How do these sensitivities vary across continental or subcontinental domains and how do they vary by month or between years?
  - (iii) How do these sensitivities differ in different regions of the world and how have they changed over time?
- (c) How will the various fractions and sensitivities defined above change as a result of expected air pollution abatement efforts?

- (i) What are the implications of expected air pollution abatement efforts for the contribution of the different fractions to impacts on human health, ecosystems and climate change?
  - (ii) How will expected air pollution abatement efforts change regional inflows of pollution (i.e., boundary conditions for regional analyses)?
  - (iii) How will expected air pollution abatement efforts change the sensitivity of regional air pollution to further abatement of regional or extraregional sources?
  - (d) How will the various fractions and sensitivities defined above change as a result of climate change?
  - (e) How do the availability, costs and benefits of additional emission abatement options compare across different regions?
    - (i) What are the source types and locations that contribute to significant impacts through transport between continental or subcontinental regions (i.e., the extraregional contemporary anthropogenic contribution)?
    - (ii) What additional abatement measures may be available in different regional domains and what are the implications of these measures for human health, ecosystems and climate change?
    - (iii) In particular, what are the costs and benefits of available measures to decrease emissions of black carbon and other light-absorbing aerosols, methane and other ozone precursors, and mercury and POPs?
10. For each of the questions above, the Task Force will need to identify the most appropriate methodologies for addressing the questions, and it will need to articulate the level of confidence in its answers, including providing quantitative uncertainty estimates where possible.

## V. Themes for cooperative activities

11. Guided by the overall objectives and specific policy-relevant questions identified above, and building upon the efforts of the Task Force to date, six themes for future cooperative activities have been identified. To a large extent, past efforts in each of these areas have been carried out separately for ozone, aerosols, mercury, and persistent organic pollutants. In its move forward, the Task force will endeavour to address these themes in a more integrated fashion, cutting across different pollutants and global to regional scales. The six themes ((a) to (f)), and the activities to be carried out under them are set out below.

### (a) Model development and evaluation

12. The activities under this theme will focus on improving the Task Force's ability to model intercontinental transport of air pollution and linkages between regional air pollution and global change. These activities include the collection and analysis of relevant observational evidence from a variety of platforms (ground-, ship-, aircraft-, sonde-, and satellite-based measurements), systematic comparison of model estimates and observations, and diagnostic evaluation and process-based comparison of models and observations. Future work under this theme will build upon the existing source receptor (SR), process tracers (PT), and event simulation (ES) series of experiments for 2001 and 2004 and may involve new simulations for the period 2006–2008, which has been studied in several other regional and global scale cooperative studies and for which there are additional sources of observational data from intensive field campaigns and satellites. Future work may also include evaluation of multi-media models for mercury and POPs and comparison to

atmosphere-only models used for ozone and PM. Efforts will be made to coordinate activities under this theme with the work of the Task Force on Measurements and Modelling and other programmes at the regional (e.g., Air Quality Model Evaluation International Initiative (AQMEII), Model Intercomparison Study-Asia (MICS-Asia), and Atmospheric Brown Clouds-Asia (ABC-Asia)) and global scales (Atmospheric Chemistry and Climate (AC&C), Aerosol Model Intercomparison Study (AEROCOM), and the Global Mercury Observation System (GMOS)).

**(b) Source Attribution and Source/Receptor Analysis**

13. The activities under this theme will be focused on developing appropriate methodologies and applying those methodologies to answer the policy-relevant questions about source attribution and source/receptor sensitivity identified above. The activities will build upon the existing SR series of experiments, the development of policy-relevant metrics (such as the Relative Annual Intercontinental Response used in *HTAP 2010*), and efforts to develop simple parameterizations of source/receptor relationships. Future activities will include simulations of future scenarios and may include the comparison of other techniques for source apportionment and source/receptor analysis, including tagging and adjoint modelling methods and observational-based source apportionment methods. Efforts will be made to coordinate activities under this theme with the work of the Task Force on Measurements and Modelling and the Task Force on Integrated Assessment Modelling and other programmes (e.g., AQMEII, MICS-Asia, and ABC-Asia).

**(c) Impacts of Air Pollution on Health, Ecosystems, Climate**

14. The activities under this theme will build upon the health, ecosystem and climate impact analyses developed for *HTAP 2010*. Future work will include refinement of the assessment methodologies used in *HTAP 2010*, development of new methods to address pollution exposures through the food chain where appropriate, and application of those methodologies to new simulations conducted as part of themes (a) and (b) to address the policy-relevant questions identified above. Efforts will be made to coordinate the work on health and ecosystems with the work of the Working Group on Effects as well as other assessments under the World Health Organization Global Burden of Disease (GBD) Project, UNEP and ABC-Asia. Efforts will be made to coordinate the work on climate impacts with the work of the Task Force on Measurements and Modelling and the Task Force on Integrated Assessment Modelling, as well as other programmes (including AC&C, AEROCOM, AQMEII, ABC-Asia, MICS-Asia, the Pan-European Gas-Aerosols-Climate Interaction Study (PEGASOS), and the research project on Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants (ECLIPSE)).

**(d) Impacts of Climate Change on Pollution**

15. The activities under this theme will build upon the existing future climate (FC) experiments (comparing 2000 and 2100 climates) to better characterize the implications of climate change for regional air pollution and intercontinental transport of pollution, including the effects on the environmental cycling of mercury and POPs. Efforts will be made to coordinate the activities with the work of the Task Force on Measurements and Modelling and other projects including AC&C, AEROCOM, GMOS, and ArcRisk (Arctic Health Risks: Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling).

**(e) Emissions Inventories and Projections**

16. The activities under this theme will focus on the development of emissions inventories and the identification and evaluation of abatement scenarios for use in

modelling analyses addressing the policy-relevant questions identified above. Future activities will build upon the existing Emissions Database for Global Atmospheric Research (EDGAR)-HTAP 2000–2005 emissions data set, the Representative Concentration Pathways developed for use by IPCC, and emission abatement scenarios developed for the revision of the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone (Gothenburg Protocol) and the UNEP/World Meteorological Organization (WMO) Integrated Assessment of Black Carbon and Tropospheric Ozone. The activities under this theme will be coordinated with the work of Task Force on Emission Inventories and Projections, the Task Force on Integrated Assessment Modelling and the Expert Group on Techno-Economic Issues, as well as other projects (UNEP, PEGASOS, the Community Initiative for Emissions Research and Applications (CIERA) and the Emissions of Atmospheric Compounds and Compilation of Ancillary Data (ECCAD) project).

**(f) Distributed Data Network and Analysis Tools**

17. Activities under this theme will focus on expanding and enhancing the distributed data network that has been created by connecting Task Force-related data servers at *Forschungszentrum Juelich (FZ Juelich)*, Washington University (St. Louis), and the Norwegian Institute for Air Research (NILU) through standard, web-based exchange services that allow unattended, machine-to-machine data exchange. Future activities under this theme will focus on expanding the distributed network to other nodes and developing web-based analysis tools that will utilize these data access web services. Efforts will be made to coordinate these activities with the work of the Task Force on Measurements and Modelling and the Task Force on Emission Inventories and Projections, as well as with the Group on Earth Observations (GEO) Air Quality Community of Practice and the Monitoring Atmospheric Composition and Climate (MACC) project.

## **VI. Expected future products**

18. In its first phase of work, the Task Force focused on the development of two assessment reports: an initial report on ozone and PM in 2007 and a more comprehensive report in 2010 addressing ozone, PM, mercury and POPs. The latter is more than 800 pages, divided into four volumes by pollutant. Within the volumes, the analyses of observations, emissions and modelling are independent for the most part.

19. In its next phase of work, the Task Force plans to produce a series of shorter, more focused reports. These reports will address one or more of the policy-relevant questions or thematic work areas discussed above in a more integrated fashion, bringing together information on different pollutants and on observations, emissions, modelling, and impact assessments, as appropriate. These reports will be published as results are available and will provide more frequent opportunities to communicate policy-relevant information. The specific topics and expected timing of the reports will be identified as the activities in the thematic areas are defined in more detail.

20. The first of these shorter reports will examine the future European boundary condition assumptions (particularly for ozone and its precursors) that are being used in the analysis supporting the revision of the Gothenburg Protocol and the EU Thematic Strategy for Air Quality. This report will draw upon the information presented in *HTAP 2010* and other recent work to assess the assumptions about future regional inflow conditions.

## VII. Activities in 2011

21. The Task Force tentatively scheduled its next meeting for February 2012. Following the Arona meeting, four planning teams will be formed to prepare for the February meeting. The planning teams will address one or two of the thematic areas described in chapter V, as follows: Team 1 will address themes (a) and (b), Team 2 will address themes (c) and (d), Team 3 will address theme (e), and Team 4 will address theme (f).
22. The planning teams will be charged to review the work that has been completed in their thematic area or areas, identify the most important questions and opportunities for further work (keeping in mind the guiding policy-relevant questions), propose tasks or experiments that can be incorporated into the workplan and identify topics for focused reports.
23. The planning teams will work through teleconferences and electronic mail and will be asked to post their recommendations to the Task Force's website for review and comment by other participants in advance of the February meeting.
24. One critical task in the planning of future work will be the development of emissions projections for abatement scenarios. This task must be performed in coordination with Task Force on Integrated Assessment Modelling, the Task Force on Emission Inventories and Projections and the Expert Group on Techno-economic Issues. The co-Chairs and planning team 3 will work with these groups to develop a plan and, if necessary, organize a workshop in autumn 2011 to bring the appropriate experts together.
25. In addition to preparing for new cooperative experiments and analyses, Task Force participants will continue to analyse results from previous efforts, publish findings in the scientific literature and make available data products and tools for use by the broader scientific community. In particular, the documentation of the EDGAR-Task Force emissions inventories for 2000–2005 will be finalized, initial versions of the Airborne Data for Assessing Models (ADAM) web interface will be made available and tools for model-observation comparison using the Task Force Data Server will be released.

## VIII. Activities in 2012–2013

26. The recommendations of the four planning teams will serve as the starting point for the development of a detailed workplan at the February 2012 meeting. New teams will be developed to carry out the specific tasks identified at the meeting, with the goal of initiating new cooperative analyses by September 2012 and providing some initial results by September 2013.
27. Anticipated activities in 2012–2013 that will continue ongoing efforts include:
  - (a) Continued development of the EMEP Centres' global modelling framework;
  - (b) Analyses of the information collected in *HTAP 2010* and the multi-model experiments conducted for years 2001 and 2004;
  - (c) Further exploration of the parameterization of intercontinental source/receptor relationships to generate policy-relevant insights;
  - (d) Maintenance of the Task Force Modelling Data Server (FZ Juelich) and the EBAS-Task Force observational data set (NILU) and their data access web services.
28. Anticipated activities in 2012–2013 that might be classified as new developments include:
  - (a) Extension of the EDGAR-Task Force emissions inventory to 2006–2008;

- (b) Multi-model simulations for 2006–2008 and initial evaluations with observational data sets;
- (c) Evaluation of emissions abatement scenarios for the period 2020 to 2050, with results available by mid-2012;
- (d) Multi-model simulations for assessing regional boundary conditions, source attribution, and source-receptor sensitivities under future abatement scenarios, with initial results available by mid-2013;
- (e) Expansion of the distributed data network and the available analysis tools for model, observation and emissions visualization and comparison;
- (f) Exploration of alternative techniques for characterizing source attribution and source/receptor sensitivities;
- (g) Analysis of insights from other efforts (e.g., AEROCOM, AC&C's Hindcast and the Model Intercomparison Project (ACCMIP)), regarding the impacts of climate change on pollution transport;
- (h) Review of methodologies for assessment of impacts of intercontinental transport on health, ecosystems and climate;
- (i) Publication of targeted reports on selected issues above.

## **IX. Activities in 2014–2015**

29. Anticipated activities in 2014–2015 include:

- (a) Improved quantification of model uncertainties based on evaluations with integrated observational data sets;
  - (b) Comparison of alternative measures of source attribution and source/receptor sensitivity under future abatement scenarios;
  - (c) Improved assessment of health, ecosystem and climate impacts of intercontinental transport;
  - (d) Improved assessments of source attribution and source/receptor sensitivity under scenarios of climate change;
  - (e) Publication of targeted reports on selected issues above.
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